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LECTURES

ON THE

GERMAN MINERAL WATERS,

AND ON

THEIR RATIONAL EMPLOYMENT

FOR

THE CURE OF CERTAIN CHRONIC DISEASES.

BY

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TO

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CONSULTING PHYSICIAN TO THE HOSPITAL FOR CONSUMPTION AND DISEASES
OF THE CHEST, ETC. ETC. ETC.,

IN ADMIRATION OF HIS HIGH ATTAINMENTS

AND DISTINGUISHED AND VALUABLE EXERTIONS IN THE

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PREFACE.

THE following Lectures were delivered last session, at the *Hunterian School of Medicine.* A portion of them have already appeared in a medical periodical, and seemed to meet with so much indulgence, that I am induced to publish the whole in a collected form, after a careful revision. The utility of publishing such a work may perhaps be questioned. It may be asked, have we not already very complete expositions of the virtues of the German Spas by Dr. James Johnson, Dr. Granville, Mr. Edwin Lee, &c.?—and is the subject important enough to require further elucidations?

To these objections I answer—that far from depreciating the works of the above gentlemen, I consider the profession and the public highly indebted to them for the light they have thrown on certain means of cure, formerly little known and still much neglected. But though they have succeeded in imparting a great amount of information in a very pleasing manner, yet it will happen, that any work on the German Mineral Springs, taken up for the purpose of *choosing* between Spas of analogous properties, will leave the reader embarrassed and undecided by the very variety of the remedial agents submitted to his choice. Formerly, when it was necessary to convince the public of the curative powers possessed by the foreign and distant Spas, it may have been sufficient to lay evidence of their value before the profession, and to describe their general medical properties, with simple hints regarding the preference of this or that Spa in different diseases; but now, when their curative agency is no longer doubted, and their access has been so much facilitated by the modern means of travelling, it is in many instances no longer a question whether one of those natural remedies shall be resorted to or not, but which is to be selected as the most appropriate. The task of facilitating such inquiry was that which I principally proposed to myself, when personally visiting the various Spas, and comparing their special effects. Having had frequent opportunities of witnessing their beneficial action in many intractable diseases, and having found the first favourable trials more and more confirmed the longer I watched the results, I thought a faithful description and record of their claims by an impartial German writer might not prove quite unwelcome to the English profession.

That numerous invalids return cured or relieved from the Spas is not disputed. But those who have not had the opportunity of devoting special attention to the subject, generally ascribe the benefit to the recreation of the journey, to the change of air, of diet, to the absence of the usual toils and cares, &c. This mode of reasoning may perhaps be considered as a natural result of the present means of obtaining information on the subject, for when the conscientious medical gentleman is called upon to recommend one of the Spas, without having personally visited and examined them, how is he to proceed? Shall he make his selection according to chemical constituents? Temperature, climatic influence, altitude, a more or less intimate combination of ingredients, &c., cause so many modifications, that he must give up the intention of being merely guided by the chemical composition. Shall he choose according to the diseases enumerated? He often finds those only accidentally cured included amongst the list of indications. Deeming it his duty to advise no remedy without a satisfactory conviction of its being decidedly indicated, he is almost compelled to repudiate the Spas in general, and to seek merely the undoubted benefit of the journey, leaving the choice of the particular Spa to chance.

That the enlivening changes of objects, sights, climate, occupation, and diet, greatly assist in disposing the organism to a favourable reception of the waters, I am free to admit, and I do not hesitate to express my conviction, that certain regions must so fill up as it were every pore of the traveller's mind, by their manifold charms and beauties, that many mere functional derangements will give way to the absorbing admiration of God's greatness, as displayed in his creative wonders. We cannot but forget our own littleness for a time, when the vast forests and gigantic mountains surround us with a constantly alternating landscape, and with the gladness of animated beings acknowledging their satisfaction in the air above and in the fields below. The forgotten and unpampered body soon imbibes the mental agility and fervour, and responds by increased action of the various contending organs. Such results may be experienced by any one whose chief complaint arises from over-exertion of body or mind, from weakening cares or emotions, when the depressed nervous system has gradually impeded the functions of any organ most liable to disorder, and laid the foundation of derangements of other organs, connected with the one primarily affected. But whilst I grant the highly important benefit of travelling, no one will expect an indurated liver, a contracted joint, or a paralysed limb, to become restored by the influence of locomotion or the most beautiful scenery. No journey or absence of six or seven weeks will infuse strength and a greater amount of iron into the circulation of a previously chlorotic and debilitated female, without some potent medicinal alteration. No mere change of living or scenery under the most favourable auspices will be expected to cure obstinate gout, rheumatic or neuralgic pains, sterility, or tendency to abortion, &c. Again, how many authentic instances are recorded of incipient phthisis, inveterate pulmonary catarrhs, hoarseness with spitting of blood, and general emaciation, &c., completely cured by a course of four or five weeks at some of the Spas? Can this have been accomplished by mere travelling?—or can it be indifferent which of the Spas are chosen, when we find numerous individuals at each watering-place, who, even while rapidly improving, will inform us how many other Spas of more or less analogous virtues they have previously tried in vain, or with deterioration of their complaints, and who bitterly inveigh against their advisers for not having recommended the present Spa in the first instance? And how can it be rationally conceived that it is of no importance to what region or Spa the sufferer directs his steps, supposing even that no proof existed of their differing results? A glance at the tables placed at the end of this volume will satisfy the most sceptical physician that such striking differences of chemical and physical properties must produce strikingly different effects.

A work, therefore, seemed needed, which would not only embody all authentic and available information on the subject, but also furnish a comparison of the curative properties of the various Spas, and thus put the reader in the same position as if he had undertaken the journey and compared the results himself. With this view I have interspersed the volume with cases *illustrating the characteristic* efficacy of each Spa, and sifted the adventitious cures from those properly due to the *prominent* curative powers of the springs, so as to enable the reader, though perfectly unacquainted with the subject previously, to judge for himself whether any given case is adapted to a proposed watering-place or not.

Though I have endeavoured to omit no fact or rational theory of importance that has come under the notice of the most competent German Spa authorities, I have sought in vain for precise directions as regards the *choice* between Spas of the same class. I therefore venture to lay down rules and explanatory views for facilitating a precise discrimination of analogous springs, and I submit them with the more confidence to the reader, from the fact, that they coincide throughout with the recorded cases of success or failure of the various Spas, being deduced from scrupulous and careful observations extending over a number of years.

The best mode of reaching the various Spas is also indicated in the present volume, but for descriptions of hotels, price of living, &c., I must refer the reader to other sources, as I thought these matters too transitory to be of permanent value, and somewhat foreign to the principal object of these Lectures.

The necessity in certain cases for avoiding particular mineral waters altogether is here pointed out with the same impartiality as their curative effects. For the Spas are far from being a panacea for all complaints to which the human organism is liable. On the contrary, I would limit their sphere of action to those cases in which the ordinary medical treatment has failed to restore the patient.

They are not only entirely *inapplicable* in acute diseases, where prompter remedial agents are required, but even in chronic disorders I would always advocate the preference of medical treatment amid the comforts of home, and under the care of those who are fully acquainted with the patient's constitution and morbid dispositions. On the other hand, when the sufferer has arrived at that stage in which the usual pharmaceutic remedies cease to forward recovery so that change of air becomes advisable to increase the prospects of health, then I think it highly useful to consult the respective virtues of the Spas, and to recommend the appropriate one, with due regard to the intrinsic and extraneous properties detailed in the present volume, for which I earnestly request an indulgent consideration.

London, June, 1851.

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PYRMONT.—DRIBURG.—SCHWALBACH.—SPAA.

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LECTURE XVIII.

OEYNHAUSEN.—NAUHEIM.

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Lecture XIX.

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ON THE

GERMAN MINERAL WATERS.

Lecture I.

Gentlemen,—The subject I have to bring before you claims to be a very important part of Materia Medica; for it not only considerably increases the number of healing agents at our disposal, but the employment of these remedies, prepared in the womb of the earth by the power of nature alone, is in many instances indispensable to effect a cure. You will be surprised at this announcement, after having become acquainted with the *numerous* remedies recommended in nearly all the diseases described in the course of pathology and therapeutics. After reading a chapter on the various ailments and injuries to which our bodies are liable; or a description of any remedy of our pharmacopœia, its effects in various doses, in various preparations, and in various intervals of administration; you may naturally exclaim, 'Why further encumber the limited memory of man, when it can scarcely comprehend the large number of remedies already tested and known? Every shade of deranged function, or altered organisation, can be met and combated by a phalanx of substances, each of which promises to cure or relieve not only this but a great many other ailments. Besides, the branches of the science we have to study are already so extensive, the subjects of examination for our licence so extremely numerous and difficult, and demanding so much study and exertion, that it would be waste of time and energy to follow a subject we are not called upon to know!'

But, Gentlemen, remember, after your examination is passed, you will not be allowed to exercise your calling without hundreds of examinations more searching and more testing than any you can be subjected to by the Examiners of a College. I allude to the inquiries of anxiety, of friendship, of love, and of tenderness, at the patient's bedside. Not only every phrase, but every glance that comes from the practitioner in whom the confidence of the family has been placed, will be weighed and treasured up. In vain will he exclaim at this critical moment—'Why did I not apply myself more to this branch or to that, so that I could meet the question with a decisive opinion? Alas! if I mistake in this instance, my career will receive a grievous check at the very outset!' You are well aware that no class of human beings have so many claims to satisfy as the members of our profession. The public are not content with our incessant toil, our self-sacrifice, our neglect of both comforts and necessary rest and enjoyment, in their service; but they wish to learn, not only the exact state of the present, but the past and future are to be revealed by us. In fact, they hardly forgive a want of information upon any subject that may possibly have an influence, direct or indirect, on health. And, pray, what has not? I have heard a respected colleague spoken slightingly of, because he failed to know the composition of this or that dish.

But to return to our subject. The mineral springs, though standing on the same ground they occupied years or centuries ago, have come considerably nearer to us through the blessing of the great world-reformers, the railroads. A place, which would formerly have been reached only after a long journey and at a great expense, becomes every year more accessible to sufferers of the middle-class. I do not hesitate to affirm, that if any of you only acquainted himself with the properties and virtues of one spa, he would have more chance of success in his future career than his competitor who is devoid of this information. For you may believe me, gentlemen, though I am not a native of your country, when I say that I have carefully watched the spirit of the English nation. I have looked around me, and inquired, who were the most zealous, industrious, persevering, enlightened, and unprejudiced labourers in the field of our science? And when I had marked out those who had done most to advance our profession by close observation and research, and by careful instruction, I inquired again, who were the gentlemen enjoying the greatest professional emoluments, and I found that they were the very same persons. It was not good luck, or birth, or connexions, or wealth, or agreeable manners. No! nothing on earth but merit; not even royal or imperial favour, can induce one tittle of reputation. Information obtained by industry, and applied with care, will ensure that which no chance can bestow. I think the facts I have to adduce will be sufficient to convince you, that if you acquire a knowledge of these mineral waters, you will have innumerable opportunities to avail yourselves of it; and many a time in your after-life will you thank the gentlemen at the head of this Institution for having afforded you an opportunity to learn that which many of your fellow-students are unable to acquire.

The spas are not quite unknown to the English public, for a great many English are found at every continental watering-place. The only regret to be felt is, that they do not resort to these fountains of Hygæia by the advice of their medical attendants, but mostly on the recommendation of some lay acquaintance, who has found relief from his ailment at a certain spa, and by merely judging from appearance, of course thinks every analogous morbid affection must be acted upon by the same means. How often disappointment must follow such advice you may easily imagine, for the spas are at no time indifferent remedies; the patient will either improve or get decidedly worse; nay, his health is sometimes jeopardised if he uses baths or springs on his own account, and without proper discrimination. I only hope that it may be in my power to awaken your interest sufficiently to induce you to follow me with indulgence in my remarks, and then you will not unfrequently be surprised at the interesting facts I shall have to bring to your notice, and perhaps confirm my assertion that you have not bestowed your attention and precious time on a subject wholly useless.

In the treatment of disease you will meet with several classes of difficulties. After having carefully investigated both the subjective and objective morbid phenomena, and satisfactorily established the nature and cause of the suffering, you proceed to adopt the most appropriate plan of treatment. But at your next visit you find that the remedies which seemed to be clearly indicated, and which confidently promised relief, have failed to answer your expectations. Suppose a case of severe rheumatism claims your care: you have given the patient *colchicum* and other approved anti-rheumatics; you have regulated his digestive functions; you have even been induced by the severity of his suffering to employ antiphlogistic remedies; and, according to theory, the patient ought long since to have left his bed and mixed with the healthy. But in sad reality, there he lies, still feeling pain in his ankle, still unable to use his limbs, and pursue his avocations, perhaps to the injury of beloved persons depending on his exertions. What is your next step?

You subject all the prominent symptoms to a fresh examination, and you conclude, that, if you could raise the power of the nervous system, by giving *quinine* for instance, the functions of the muscles and muscular organs would be strengthened, and the morbid sensibility diminished. Some relief has been obtained, but only temporarily, and the pain, inconvenience, and disability, still exist or return, to the silent reproach of human skill. You attack the enemy from another point. You give *iron* to improve the strength of the vital fluid, and thus induce a more energetic organic metamorphosis, a heightened tone of the vascular system, and an increased action of the excretory organs. The struggle between diminished irritability and increased nervous sensibility is often allayed by raising the former, and thus restoring the equilibrium necessary to health. You then resort to *iodide of potassium*, which frequently cures similar states of disease, by increasing the power of the absorbent vessels, and causing effete exudations of serum to become absorbed and excreted. You have employed vapour baths, external derivatives and internal revulsives, and though each remedy (when judiciously selected) helped to allay the symptoms, still days, weeks, nay months have passed, the disease has become chronic under your hands, in spite of the most careful and approved treatment. You must not suppose, gentlemen, that I fill your mind with imaginary fears. Though fortunately rare, such cases will occur and be the more disappointing, inasmuch as you were justified in expecting success from each of the plans adopted; and, unhappily, this disappointment is frequently allotted to the followers of our arduous profession, notwithstanding our daily progress, and the almost hourly discovery of some new remedy. It is at this stage that people throw themselves into the hands of quackery, relating how many bottles of medicine and boxes of pills they have "swallowed," as they call it, how they have been given up by the profession, &c., &c. The quack, whose only object is to gratify his desire for lucre, will of course not discourage the applicant. He always promises a certain and speedy cure, while the conscientious man of science merely pledges himself to do his best. Thus the empiric at once gains a temporary advantage. He then works on the credulity, the prejudices and fears of the inexperienced sufferer, as long as his purse or patience will bear it.

But you might ask, gentlemen, are we not perhaps blinded by prejudice against those illegitimate and unqualified practitioners whom we call quacks? Is it not possible that Mr. A. or Mr. B. does cure diseases which have resisted the experience and knowledge of an individual member of our profession? To this I answer, that those uninformed or misguided persons themselves, give the best proofs of the delusions they practise on the confiding applicant. For, if the hundredth part of the cures they advertise were true, no advertisement, no appeal to the public, no unveiling of the so-called failings of the profession were necessary. You may be convinced, that if an individual had been cured as described, and constantly placed under the lay reader's eye, this one fact would attract more patients than thousands of public self-laudations.

Those, therefore, who degrade themselves and offend common sense by promising and publishing cures to the public, who are unable to discern the impossibility of the promises and allegations, would not thus put themselves into the pillory, did they not feel the hollowness and unsoundness of the foundation upon which they stand, and that without this step they could not secure a sufficient number of adherents. This circumstance is almost more convincing to my mind, than many powerful arguments against the probability or possibility of their assertions.

Your duty towards the public demands as imperatively as your self-interest, that you should leave no means untried to preserve the patient from the fangs of such dangerous men. On the other hand, what gratitude will you earn, what increase of reputation, if, on the point of giving up treatment, you remember that similar cases have been cured by a certain spa, and you are thus instrumental, by its recommendation, in restoring the patient's health while he is far removed from your sight!

A difficulty I should wish to allude to, is the clear indication of a remedy, which, however, may be contra-indicated by other circumstances. For instance, a patient presents himself with spitting of blood. *Acetate of lead* and *opium* would relieve him; but his bowels are in a confined state, and would become more so by the remedy in question. Or, in another instance, it may be necessary to produce alvine evacuations, whilst the irritated or inflamed condition of the bowels forbids the use of an ordinary purgative. In these and many similar cases you will find it extremely useful to employ some of the imported mineral waters, for they will often answer the required purpose, without causing the secondary inconvenience or injury you would have to fear from the same remedy in its pharmaceutical preparation.

Another class of difficulties ought not to be passed over, for they will occur in practical life. Your advice will occasionally be asked by persons complaining of some deviation in the function or sensibility of certain organs, and still, after having accurately examined the phenomena, you may find that actual disease does not exist. There are *states of transition* from the normal performance of the harmonising human faculties to disorder; and why should this not be the case? In nature, no sudden revolution occurs. You do not find summer to-day and winter to-morrow, nor a blooming youth of this moment changed into a decrepit aged being of the next. An applicant for medical relief may complain of languor, depression, debility, emaciation, and still you may arrive at the conviction, that no organic or functional derangement, demanding active medical interference, is before you. What seems functional derangement is perhaps, in this instance, only morbidly increased sensibility, or momentary and passing predominance of one system or organ over another. A desire arises in your mind to recommend steps, which form the intermediate link between dietetic rules and pharmaceutic preparations. This you can satisfy by ordering a mineral water, composed of remedial substances, treated of in the materia medica, it is true, but which constituents, though present in comparatively small proportions, act more energetically than larger doses of the same remedies in the ordinary form, being, at the same time, always more easily received and assimilated. The reason probably is, the greater degree of solution and intimate union which they possess when flowing out of the soil, where they have been kept in this combination for years. They may bear the same relation to the ordinary remedies, which food partially dissolved and liquid bear to the common products of cookery. They certainly enter the digestive organs as more congenial bodies, and their active principles so finely divided are, no doubt, fit to be immediately imbibed into the absorbent vessels, and to enter the circulating fluids without performing (as is the case with many artificially prepared medicines) the tortuous route of digestion before their action is exhibited. In the complaint above mentioned, you might give the Franzensbrunnen, in small quantities — say a wineglassful three times a-day, with some warm water, or in a heated glass; and when at your next visit you might expect little change, you may often experience an agreeable surprise, by the great improvement that has taken place, confirming your judgment that it was a mere transition from health to derangement, and dispensing with further treatment. Thus, a slight help to prevent the formation of disease, should be considered as a more sacred performance and deserving more gratitude, than even the cure of the developed disease itself. And I venture to assert that, very frequently, nature gives us distinct hints of a tendency to a disturbed equilibrium between the concordant living forces, though unfortunately, they are generally disregarded by patients, and occasionally by the physician himself. But I am sure you will agree with me, gentlemen, that it is a very meritorious principle to search, with the utmost assiduity, into these first deviations of natural functions, and thus often prevent the development of actual disease, in its formidable or uncontrollable character? From the imperfection of everything human, you will not, of course, always succeed. But I can affirm, from the experience I have had in the occasional administration of mineral waters for the last five or six years, that their effects in this respect are extremely gratifying and satisfactory. Often have I prescribed the one or the other, at first, as an innocent experiment or an expectative remedy, without hoping to find the beneficial results that actually ensued. Used with proper discrimination, they will often be found extremely valuable arms in checking the advance of many an insidious enemy, and causing him to retreat for ever.

Allow me to mention a case in point. A foreign merchant, of short and slender stature, with an extremely active mind, related to me about a fortnight ago, that he was awakened every night by a circumscribed dryness on the tongue. He felt as if a portion of the tongue, about the size of a shilling, became so dry, rough and constricted, that he was obliged to get up and rinse his mouth for a few minutes, when the dryness gradually passed off. I examined his tongue; it was perfectly clean; his appetite, motions, and sleep were all perfectly normal, with the above exception; his pulse regular, but rather weak, himself in excellent spirits, and merely annoyed by this circumscribed dryness, which he experienced at night. Now, one moving about the whole day from counting-houses to auctions, and from auctions to counting-houses, the busiest amongst the busy, could scarcely be called ill; yet he did not enjoy health, for the dry spot became larger and larger every evening. It did not appear at a fixed period, or we might have thought it of a disguised intermittent character, and found quinine indicated. In vain I searched for a name or a class which I could refer his complaint to, and I came to the conclusion that it was merely an indication of some incipient stage of, or tendency to disease, which might be checked by supplying the constituent element apparently deficient. I asked myself, supposing his whole tongue were in the same state, what would be his requirement? I answered, There might be an abnormal deficiency in the materials composing the gastric juice, proceeding from a deficient sanguification, and this, consequent upon continuous mental exertion—in fact, a tendency to typhus fever. The weakness of the pulse, and the very great and consuming activity of the mind acting upon a slender frame would make this more probable. He also mentioned that the slightest trifle excited him to uncontrollable anger; whereas under the influence of country air, when he took cognizance of the same things, they scarcely produced perceptible vexation, but became matters of indifference, and he felt every reason to be perfectly satisfied with his domestic and mercantile affairs. 'It is better air I want, doctor,' was his constant exclamation, 'and that you can't give me here in this city.' I asked myself why is it that he is perfectly well and cheerful under the influence of sea or country air? Because the stimulus of the pure bracing atmosphere promotes the power of circulation, and consequently improves organic metamorphosis and reproduction, whilst in this confined spot, the exhalations of so many human beings impregnate the air with impurity and warmth, causing it to expand, and thus allowing to each individual inspiration a smaller quantum of oxygen. It was therefore my task, according to the idea I had formed of his complaint, either to introduce a substitute for the natural stimulus, or to supply that element to his organism, which would have been formed by the stimulating influence of free air. I therefore recommended *Rakoczy*, one of the springs of Kissingen, containing as chief ingredients, chloride of sodium and iron; but as, unfortunately, it was too late to send to the store of the importer, I prescribed what, in the words of Dr. Golding Bird, is 'no medicine but food,' viz., iron combined with chlorine, in the form of Tinct. ferri sesquichlor. x. ♏. three times a day. The result entirely answered my expectation. The complaint gradually abated, and at last entirely disappeared. Although I had no opportunity of testing in this instance the power of mineral waters, still you will allow it to belong to the category of *hints of nature*, without any marked illness.

Another case, which lately fell under my observation, is perhaps not undeserving of notice. A gentleman, about thirty years of age, who began to study medicine, and afterwards turned to mercantile pursuits, underwent much anxiety and mental labour in the year 1846. For twelve years past he has felt daily, a few hours after each meal, a burning sensation in the left cardiac region, extending upwards to the shoulder; he is also frequently affected with headache in the occiput, particularly in the evening. He tried many remedies and dietetic changes in vain, and latterly *carbonate of potash*. He resides in a healthy suburb, daily takes much exercise, and lives with the greatest regularity, as regards meals and rest; even partially abstaining from smoking. Finding the subjective phenomena unconnected with any structural or functional disorder, I considered the free carbonic acid, with carbonate of soda, and the other ingredients contained in *Fachingen* water, would improve his abdominal circulation and digestive functions. I accordingly recommended this water, and was extremely gratified when, at his next visit, he declared himself entirely free from the inconvenience which had molested him so many years. He complained of a slight return at our following interview, but ascribed it to a fault of diet, and was advised to continue the same water. At his next visit, about a fortnight after the first, his assurance of being perfectly well, obviated any further medical or pharmaceutical interference.

Having heard so much of mineral waters, you will ask, perhaps, does not the name indicate that certain mineral substances are dissolved in the springs; and if so, why could we not with the knowledge of their composition, combine the same substances in the same proportions, and expect similar results?

I answer, if only soluble remedies were contained in them, you might certainly easily imitate them; but although these waters appear perfectly clear and transparent, every one of them contains substances insoluble in common or distilled water. Take, for instance, Rakoczy: we know by analysis, that it contains eighty-five grains of solid ingredients in sixteen ounces. Of these, sixty-two grains are chloride of sodium, two sulphate of soda, nearly a grain of carbonate of soda, soluble; but then we have carbonate of lime, carbonate of magnesia, and carbonate of iron, which are insoluble in ordinary water. But what agency keeps them in solution? It is carbonic acid, which impregnates the water to the amount of twenty-six cubic inches in the sixteen ounces. Were we to employ any fixed acids to dissolve the lime, magnesia, and iron, the chemical composition of other combinations would be changed. But here the excess of carbonic acid keeps these bodies in solution, and they are immediately precipitated, on its escape. It not only dissolves the one substance without disuniting combinations of others, but it enters the system charged with these particles, and presents them to the mouths of the absorbent vessels in this highly diluted condition; whilst, at the same time, it promotes their direct absorption by naturally exerting a stimulating power on the vascular and nervous system. Thus you may understand why six-tenths of a grain of iron imbibed into the duodenal lacteals, with the abundance of the gaseous acid, may exercise a more tonic exciting influence on the circulating system than three or four times the quantity of pharmaceutic carbonate of iron, which has to be dissolved in the gastric juice previous to absorption. The same holds good of carbonate of lime, of magnesia, of silex, and many other substances which are apt to produce irritation of the digestive organs in the ordinary form of administration. From this consideration, you will clearly perceive that the great modification of the differing reception must not be disregarded, and indeed daily experience amply demonstrates the different effects. Many an individual, for instance, will bear a pharmaceutical form of iron, with whom the Homburg water would cause too great vascular excitement, and *vice versâ.* A great many spas possess similar ingredients, but in different proportions; and their efficacy generally corresponds with the predominant constituents. The other ingredients are undoubtedly admixed to prevent a too powerful action on any organic sphere. Suppose sulphate of soda or magnesia to be the chief ingredient (as in *Püllna, Saidschutz,* &c.) the alvine secretions and evacuations might be excited in too high a degree, the sanguification might become too much weakened to perform the nutritive and plastic function of the whole body, and therefore we see carbonate of lime and of iron added in small proportions, so as to give a certain check to the solvent and liquefying power, and to increase the tone and resistance of the blood. Where iron is the chief ingredient, a too vigorous action of the vascular system is counteracted by the addition of a proportionally small quantity of lowering sulphates, and of solvent chlorides. But you will argue, as an objection, that we have been taught in modern therapeutics the great advantage of simple treatment, and of not employing too great a complication of remedies. No one, gentlemen, can be a stronger advocate for simplification of our prescriptions than I am.

Hundreds of times have I deplored the employment of so-called adjuvantia and corrigentia, particularly in successful terminations; because the experience of the value of a remedy is often lost through these combinations. When the disease presents itself, you combine those agents which you consider most likely to produce a cure; and the more perfect the success, the more you will have to regret the uncertainty to which of the remedies you have to attribute it, so as to be able to use the same means with greater confidence in similar cases. It is always more desirable to fix the appropriate remedy in the simplest form that will promise easy assimilation, and then both success and non-success will improve your experience and therapeutic knowledge. But how can you reconcile my recommendation of simple remedial treatment with the favour in which I hold the mineral waters professedly embracing manifold combinations of remedies? I answer, though it is necessary to be guided in the choice and dose of the mineral waters by the knowledge of their chemical composition, each of them must be considered as one whole, acting on well-defined abnormal conditions with a more or less certain effect, according to the records of eminent English and foreign writers; and as you will experience in your own practice, if I can succeed in persuading you to give them a trial in the course of your career. Having informed you that a gaseous acid is the chief solvent of the mineral waters, you will at once see the difficulty of artificially imitating them. Nevertheless, the great advantage derived from their use, and the impossibility of obtaining some of the most important ones, induced several attempts to prepare fictitious mineral waters. The most successful was that of Dr. Struve of Dresden, who made careful analyses of the several springs, and then succeeded, after years of unceasing labour, in producing fictitious mineral waters, which resemble the natural in taste, colour, specific gravity, and, above all, in the results of chemical analysis and medical treatment. He endeavoured to follow the process apparently employed by nature, in impregnating the springs with the various constituents; and he argued that the effects must be likewise identical. In several cities of Europe he founded establishments where fictitious mineral waters may be obtained. What is called the 'Brighton pump-room' is one of these establishments; and many instances are on record of cures performed by these waters, and of specific effects only belonging to the respective natural waters. Some go even so far as to claim a preference for the artificial waters, from the circumstance of their being more easily obtainable, and of their losing less carbonic acid by distant carriage, &c., &c. But, gentlemen, though our present knowledge of chemistry can discover no perceptible difference, who would assert with complete assurance, that some new test might not in a few years' time discover substances in the springs, which were unknown at the time of their last analysis? Before the discovery of iodine and bromine for instance, the efficacy of *Kreuznach* or *Adelheidsquelle* in scrofulous diseases may have been attributed to the presence of chloride of sodium and chloride of calcium, and an exact proportion of these substances in distilled water might have been thought a very correct imitation. That there are active principles yet undiscovered in some mineral springs, we are justified in surmising, if we take cognizance of the astonishing changes produced by certain spas called 'chemically indifferent,' because their constituents are scarcely distinguished from those of common water. It is a singular fact that these very spas are among the most powerful. Take for instance *Wildbad*, near Stuttgardt, which is particularly renowned for curing inveterate gout, *arthritic* paralysis, and contractions after wounds. What do you suppose its constituents to be? No more than 3½ grains in 16 ounces, and these are about two grains of chloride of sodium, half-a-grain of carbonate of soda, some carbonate of magnesia, of lime, manganese and iron, with some silex. Are these few grains able to cause absorption of substances deposited in the joints, or restoration of pliancy and power to limbs, which have for years resisted the manifold means that knowledge and experience have devised? Put the same ingredients into ordinary water of corresponding temperature, and see whether you will obtain results at all approaching those frequently experienced at Wildbad? Is it because the warmth of the water is identical with that of blood, and requires neither heating nor cooling? You have only to think of *Gastein,* in South Tyrol, the temperature of which is about 111° F., and which must be cooled for bathing, and still its reputation for the cure of atonic gout, of paralysis, and of spasms through deficient nervous power, almost surpasses that of Wildbad. What are its constituents? Still less, only 2½ grains in sixteen ounces—viz., 1½ sulph. of soda, then some sulph. of potash, chlor. of sodium, carb. of lime, &c. It is true, an undetermined quantity of animal substance, called *glairine,* has been found in it. But is that to explain the visible transformations happening within a short period before your eyes? The great efficacy of these and other spas has been testified by English physicians and surgeons of high standing, and by numerous sufferers of this and other countries. The theories which I shall have to lay before you in explanation of their powers may leave the impression on your mind, that it is the task of chemical progress to unravel some mysterious properties as yet concealed from our observation. And, if no attempt at imitating these spas has ever been thought possible, have we not a right to conclude, that in the springs which possess powerful ingredients, other substances co-operating in the effect may be as yet hidden from us? Why can the spring of the 'hôpital' in Vichy, be freely employed, whilst that of the 'Grande-grille' must be administered with great circumspection, though both possess nearly the same chemical constituents, and belong to the same spa? Because the vegeto-animal substance, incapable of imitation, is more abundant in the former.

Another objection to artificial waters may be found in the circumstance that many salts obtained by evaporation, and concentration of a water, may possibly have been formed through this process, without having previously existed under the same combination in the liquid; in fact, it may rather be a product than an educt of analysis.

Nevertheless, they are excellent substitutes for the genuine waters; although when these latter can be obtained, it is my opinion that they ought decidedly to be preferred. On the other hand, great advantages may be derived from certain imitations; thus, at Gros-Caillou, rue de l'Université, Paris, they produce a solution of magnesia in an excess of carbonic acid, which is so saturated that a pint contains nearly half an ounce of magnesia; thus about four grains can be given to a child in a table-spoonful of this solution, either as an absorbent, as an antacid, or as an aperient, &c.

I ought, perhaps, not to conclude this preliminary lecture without referring for an instant to the manner in which the imitation of the waters might be performed. The first process must consist in disengaging the carbonic acid by treating carbonate of lime with hydro-chloric acid. The latter combines with the lime by its stronger affinity, forming hydro-chlorate of lime, while the carbonic acid is disengaged. The carbonic acid gas is then passed through a solution of potash and water, in order to free it from any accidental admixture of hydro-chloric acid, and is subsequently conducted into the water by an hydraulic press, which is so constructed that both the water and the gas arrive at the same time in the condensing vessel, after having been brought into forced molecular contact by a very considerable pressure. The water being sufficiently impregnated with carbonic acid, you dissolve in it the necessary proportion of the salts of soda and a portion of gelatine (as a substitute for the natural vegeto-animal substance). Suppose, then, you require carbonate of lime, carbonate of magnesia, and carbonate of iron, you precipitate these substances out of hydrochlorate of lime, sulphate of magnesia, and sulphate of iron, by means of bicarbonate of potash. These will readily dissolve in the aerated water, though insoluble in common water. Some more carbonic acid is introduced by the hydraulic press to complete the solution, if necessary, and the water is then well corked, and fit for use.

The spas themselves are generally resorted to between the months of May and October (inclusive). The course lasts from three to six weeks. Their effects invariably continue for a long period, and the most successful cures frequently take place months after the patients have rejoined their family circles. When immediate improvement ensues, it is often of a less durable character. This lasting efficacy particularly adapts them for the treatment of chronic diseases. In most spas, bathing and drinking of the respective springs take place. Some, however, are merely employed internally, others only externally.

The mineralized mud of some is used separately as a highly curative external remedy; in others, the abundant evolution of carbonic acid is used for general and local gas baths. Where the temperature is too high to allow of immediate employment, ingenuity is taxed for contrivances most calculated to lower the heat, without influencing or altering the composition of the ingredients partially held in solution by the high temperature. If the temperature is too low for bathing, the *bade-meister* (bath-master) will show you in one place how the *baignoires* are warmed by subterranean steam, so that the spring may not lose its carbonic acid and have important substances precipitated by being heated. Another will explain that warm water is mixed in his baths in such a proportion with the spa water as not to impair its properties, &c. At others you have douches of various height and power. In some you will see *ascending* douches, to which many cures are attributed, particularly in several diseases of women. In others again friction is employed with the douche as a great auxiliary to the medical treatment. (This is particularly well understood and managed at Aix-la-Chapelle.) In fact, when you visit any spa, you will be astonished at the manner in which every particle of the natural gift is brought to bear upon diseases. If the source be on a higher situation than the baths, you will see this taken advantage of to fill the baths by pressure from below, so that the water flows upwards in a wave-like manner. You see a shaft constructed in which the water rises and is made to splash over and to fill the circumvenient air with its vapour and exhalations for medical purposes. The quantity of the water taken internally varies considerably, and as a rule is gradually to be increased.

Generally a band begins to play about six in the morning, waking the visitors from their slumbers, and shortly afterwards they are seen emerging from their habitations one by one to drink at the appointed source their prescribed quantum of the healing draught. In the intervals of drinking, they take walking exercise for about a quarter of an hour. About an hour after a light breakfast, the baths are taken. The diet is regulated accordingly. The curative power seems to be evolved by a slow reaction, which the *ensemble* of the healing influences produces in the human system. If this reaction is speedily exhibited by signs of a violent revolution, as headache, giddiness, depression, lassitude, restlessness, want of appetite, obstruction or diarrhœa, distention of the abdomen, feverishness, &c., immediate discontinuance is necessary.

The course might be resumed as soon as a more favourable impression can be reckoned on. 'Bath eruption' occasionally appearing after a few weeks, and then disappearing without medicinal aid, is considered a favourable sign.

Both the spas and mineral waters, however useful in chronic, must be entirely avoided in acute diseases, in inflammation of vital organs, inflammatory fevers, &c. They are also contra-indicated in hectic fever, in formed tuberculosis, in carcinomatous degenerations, in aneurisms, in congestion of the lungs or brain, &c. In fact, before recommending a spa, the subsequent reaction and unfailing excitement must be taken into almost more serious account than the direct influence itself. However, if contra-indicating circumstances are absent, and you have to select a bath for the victim of long-continued suffering, you will weigh the strength of his constitution, you will acquaint yourselves with the morbid influences that have acted on him since his youth, deteriorating the functions, changing the structure, or vitiating the fluids of vital organs; and when the proximate cause of his present ailment has thus become clear to your mind, you will fix on a spa by which it can most appropriately be counteracted, taking into consideration its prevalent constituents, its climate, and its height above the level of the sea, &c. &c. The great number of powerful springs in so many modifications, certainly increases the trouble of fully acquiring a knowledge of them; but the thankfulness which arises from the enjoyment of restored health, and the merit of having carefully selected for your patient the appropriate spa, will amply repay the labour and attention which you may have indulgently bestowed on my observations.

LECTURE II.

GENTLEMEN,—The springs furnish a natural point of classification by the sensations they produce on our body through their varying temperature. The more a spa approaches the temperature of the blood, the less animal heat is withdrawn by the contact, and the greater the perception of warmth. For convenience sake let us designate, with Vetter, those springs having a temperature below 15° Reaumur or 66° Fahrenheit, *krenæ*,* or cold springs, and those of which the temperature exceeds 28° Reaumur or 95° Fahrenheit, *thermæ*, or hot springs. Those that range between 15° and 28° Reaumur, or 66° and 95° Fahrenheit, may be considered as of intermediate temperature, still depriving the body of some heat, but unable to display the medicinal effect of cold; they are designated as *pegæ*.† Mineral waters, without reference to temperature, are also termed *pegæ*. Perhaps it would not be out of place here to acquaint you with the readiest mode of reducing degrees of Reaumur into those of Fahrenheit. You will be aware that in Germany, and many other parts of the continent, the scale of Reaumur is used, in which the temperature between the freezing and boiling points of water is divided into 80°. In England, Fahrenheit is exclusively employed, who divided the same amount of varying heat into 180°. Thus 8° of Reaumur correspond with 18° of Fahrenheit, or 4° of Reaumur with 9° of Fahrenheit. If they had both allowed the freezing point to begin at Zero, the calculation would have been extremely simple. Fahrenheit having, however, begun his scale 32° below the freezing point, you will have to add this number after having found the exact proportion of degrees corresponding with those of Reaumur.

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* From κρήνη—source.

† From πήγη—spring, salient water.

If the number of Reaumur is divisible by 4, for instance, 40° Reaumur, you have 10 fours of Reaumur, which are equal to ten nines of Fahrenheit = 90°, add to these the 32° below the freezing point, and the result will be 122° of Fahrenheit. If the Reaumurian number is not divisible by 4, for instance, 7° of Reaumur, multiply first with 9—you obtain 63; divide then by 4, result $15\frac{3}{4}$; add 32, and you find $47\frac{3}{4}$° Fahrenheit = 7° Reaumur.

Another natural division may be derived from their local variations, which do not fail to exercise a considerable influence on their medicinal efficiency. Their respective altitude modifies the atmospheric pressure, and displays properties of its own, whilst the temperature may be more analogous to higher latitudes.

The diminished pressure and greater purity of the air in higher situations invigorate and stimulate the weakened nervous system, and diminish passive pulmonary blennorrhages, whilst they would disagree with persons of irritable thoracic organs, exciting hæmoptysis, congestion, or inflammation, where a tendency to such diseases already exists.

It has been calculated that the warmth of the air diminishes by 1° Reaumur for every 500 feet of height. But however applicable this law may be in the higher regions, it is less so nearer the earth, the temperature being modified by the direction of the mountains, geographic latitude and many other circumstances.

Some of the Salzburg and Tyrol mountains approach Mont Blanc and Monte Rosa in height, the Gross Glockner rising to upwards of 11,000 feet; and the mineral springs of the upper valley of the Inn (Upper Engaddin) at St. Moritz, are situated 4000 feet above the sea, several in the lower valley near Inspruck only lie 1700 feet high.

The higher or lower situation of the *Bavarian* springs depends on their vicinity to the Southern Alps, the Bohemian Forest, the Fichtelgebirge and the adjoining Franconian mountains, or to the river districts of the Danube and Main.

The same relation takes place with the spas of *Austria,* their altitude being determined by the neighbouring mountains of Styria and Carinthia, or by the Danube. If the course of the river be pursued upwards, you will perceive the proportionate height of the adjoining springs from that of the following towns:—*Vienna* is situated nearly 500′ above the level of the sea; *Passau,* nearly 800′; *Ratisbon,* 1100′; *Augsburg* on the Lech, 1400′; *Ulm* on the Danube, about 1100′; *Munich* on the Isar, 1600′; *Memmingen* on the Iller, south of Ulm, nearly 1900′. In the whole of this river district of the Danube and Inn no spring is situated lower than 500′; several, on the contrary, much higher. You observe the range of fall to be 1300′ between Memmingen and Vienna.

In *Bohemia* those near the Bohemian, Fichtel, Erz, and Riesengebirge are higher; those situated more in the centre of the kingdom, lower; *Prague,* the capital, occupying nearly a central position, lies about 500′ above the sea, the surrounding mountains being from 2000 to 3000 feet high.

In *Saxony* and *Thuringia* those springs belonging to the river domains of the *Elbe,* or to the fertile plains intersected by the river *Unstrut,*[*] do not lie higher than 300′, some even lower; while those approaching the Thuringian Forest, and Erzgebirge, are much higher. *Dresden* on the Elbe, lies only 280′ above the sea; *Meissen* on the Elbe, about 200′; Leipsig on the Elster,[†] 300′; whilst nearer the Thuringian Forest, *Erfurt,* to the west of the Saale,[‡] lies nearly 600′ high; Weimar, to the north-east of Erfurt, 650′; Gotha, to the west of Weimar, 900′.

The springs of *Wurtemberg, Baden,* and the *Rhine* are determined, as regards their altitude, partly by the vicinity of the Black Forest, Taunus, Eifel, or other mountain-ranges, bordering on the Rhine, and partly by their more northern or southern position. The level of the Rhine is, near Basel 765′ above the sea, near Mainz, 256′, near

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[*] Enters the Saale, south of Merseburg.

[†] Joins the Saale above Halle.

[‡] Falls into the Elbe about 52° lat.

Coblenz, 190′, near Bonn 138′, near Cologne, 112′, whilst the highest peak of the *Black Forest* rises to upwards of 4000′, and of the Taunus to 2600.′

Most of the Silesian springs are distinguished by an elevated position, being situated near the highest points of the county of Glatz and the Riesengebirge. The height of the *Schneekoppe* is nearly 5000′, that of *Breslau,* on the Oder, only 400′. The spas to the south of Breslau, near the mountains, range in their altitude between 800′ and 1700′.

Among the springs of *Electoral Hesse* and *Westphalia* those only claim greater altitude which arise near the Westerwald, the Rhön, the Haar, the Teutoburg forest, and the Weser mountains. The summit of the Rhön, at the south-eastern boundary of Fulda, rises to nearly 3000′. *Fulda,* itself on the Fulda,* lies about 800′ above the sea; *Cassel,* on the Fulda, more northerly, about 500′; *Giessen,* on the Lahn,† about 400′; *Hanover,* on the Leine, only 240′.‡ The mineral springs of *Pyrmont* and *Hofgeismar* between 400′ and 500′.

Near the shores of the North and Baltic Seas, in the absence of mountain-ranges of importance, the mineral springs are found to be comparatively in low situations, becoming of course lower the more they approach the sea.

But a high position must not be considered as invariably rendering the air too keen or bracing. Thus *Ischl,* in Austria, to the east of Salzburg, situated in a highly mountainous region, at an altitude of 1400′, enjoys a very mild and temperate climate. The same climate obtains at *Pfeffers,* in Switzerland, near the Rhine, upwards of 2000′ high, and at *Leuk,* on the Rhone, upwards of 4000′ over the sea.

If we examine the constituents of the springs, and compare them with those of the mountains in which they rise, we find a great similarity. Those springs found in flat, sandy plains, consisting of alluvial land, greatly differ from those arising out of primary rocks, stratified mountains, or volcanic rocks.

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* Falls into the Weser.

† The Lahn joins the Rhine near Coblenz.

‡ The Leine is a tributary of the Aller which falls into the Weser below 53° lat.

In Switzerland, the central mountainous region of our globe, we find a great abundance of powerful springs in the valleys of the Rhone, the Rhine, the Engaddin, the Aar, at the foot of the Jura, of the Bern mountains, and of Mont Blanc.

Their composition corresponds with the non-volcanic character of the mountains. The thermal springs enjoy a great reputation for efficacy, but possess a comparatively small quantity of ingredients. The *krenæ* (cold springs) contain a considerable quantity of carbonic acid, but less iron and salts of soda; and the remarkable want of common salt in Switzerland, is also apparent in most of its springs.

In the mighty ranges of primary mountains passing through Scandinavia, a decided want of thermal springs is perceived, though there are numerous cold springs, with an inconsiderable quantity of solid ingredients.

The flat countries near the shores of the North and Baltic Seas cannot boast of possessing important mineral waters, with the exception of some salt springs; but there is greater abundance in the mountainous centre and south of Germany.

To explore the origin of the mineral springs, no pains or expense were spared in former times, by digging deep into the bowels of the earth; but the results were unsatisfactory, as might have been expected. To arrive at a somewhat clearer perception, let us first consider *the relation* between the atmosphere and the surface of the earth. The different non-mineral springs, proved by their fixed and volatile constituents that they are impregnated with particles belonging to the superficial strata of the soil, through which they have to pass. Thus the springs of gypseous mountains contain sulphate of lime; those arising in marshy countries often abound in vegetable extractive matter; whilst those springing out of primary mountain masses contain but few solid ingredients. This connexion may likewise be traced in the constitution of most mineral waters. It is true you sometimes find saline springs originating in strata of lime, or sulphureous, ferrugineous, and saline in close vicinity, coming out of the same soil. Take for instance the renowned *Wiesbaden*, one of the most celebrated Halopegæ (salt springs); a few leagues to the south-east you see *Weilbach*, a powerful *Theiokrene* (cold sulphur spring); turn to the north, and within another few leagues you have the celebrated chalybeate spring of *Schwalbach*. Again, there is *Ems* on the Lahn; a hot spring so celebrated for its beneficial influence in certain pulmonary and laryngeal diseases. Proceeding a few miles to the east, you meet with the cold springs of Geilnau this side, and of Fachingen the other side of the Lahn.

It has been assumed, that the whole mass of water on the globe remains constantly of the same amount, though undergoing various changes of form by atmospheric influence. The water attracted and imbibed by the surface of the earth, penetrates to different depths according to the more or less yielding and porous character of the recipient layers. It then collects in the interior and begins its solvent and chemical action on the surrounding strata, with results corresponding to their character. Of course the deeper they penetrate, the less they are influenced by the composition of the superficial layers, or by variations of temperature.

It is of importance to consider whether a spring has a merely *local* origin, or whether it owes its existence to the *general* character of the mountainous formation.

Thus most acidulous and thermal springs can be traced to certain characteristic mountain chains, whilst sulphureous and chalybeate springs are mostly independent of the general character of a region, and seem to stand as isolated products of local causes. This is, for instance, the case with the chalybeate of Alexisbad (near the Harz), the sulphur spring of Northeim (east of Driburg), &c.

As regards the Eifel and Taunus mountains, the Thermæ of Bertrich (west of the Moselle), Ems, and Wiesbaden (east of the Rhine), they no doubt originate from the deeper volcanic basins of these mountains, and the neighbouring cold acidulous springs of Geilnau, Fachingen, and Selters, from higher lime-strata, containing slate.

A similar relation may be observed in Bohemia. The natrotherma (hot alkaline spring) of Teplitz (south of Dresden) arises at an elevation of 700′, that of Carlsbad at 1100′ (south-west), the cold chalybeate of Franzensbrunn at 1500′ (to the west of Carlsbad), Alexandersbad, still more to the south-west, 1900′, and Steben, to the north, 2000′ (on the Saale river).

In the ramifications of the Riesengebirge, to the east of Teplitz, the sulphur-spring of Warmbrunn arises at 950 feet, the tepid spring of Landeck (near the Sudeten mountains) at 1400′, and the cold acidulous springs between 1100′ and 1800′.

The hot springs of Leuk (on the Rhone), arising at a height of 4000′, and of Gastein (below the river Salzach) at nearly 3000′, only form an apparent exception, as I shall be able to show you.

Springs of a more superficial origin generally belong to the latest strata of gypsum, shell-lime, rock-salt, peat, and coal. They are mostly found in flat countries, in plains of alluvial land, intersected by stratified mountains, of moderate height. No spring of this class lies at a greater elevation than 600′ or 800′.

They generally contain few volatile ingredients, and are particularly deficient in free carbonic acid. They either possess few solid constituents, or abound in culinary salt and earthy salts. Some of these, however, are rather admixed than thoroughly dissolved and amalgamated. Their composition is, further, in some degree dependent on atmospheric or climatic influences, even as regards quantitative proportions.

Among this group must be reckoned:—

1. Iron springs, particularly those that contain little carbonic acid. They are found near strata of peat, as Muskau (on the Neisse, a tributary of the Oder), and Hofgeissmar (south-east of Driburg). They generally arise in

marshy countries, under strata of iron ores, of ferrugineous clay, of aluminous slate, and of peat. But with these must not be confounded the chalybeates which abound in free carbonic acid, and possess a volcanic origin; the surrounding layers of moor may, in their instance, rather be considered as the products of the springs; (for instance, near Marienbad.)

2. Some *cold sulphurous springs* are to be enumerated here, superficially arising out of alluvial land (sometimes from strata of clay), for instance, Northeim (east of Driburg); or they may originate deeper in stratified mountains. Sweet springs sometimes penetrate into strata of coals, inducing a sort of fermentation and decomposition of the sulphates.

3. Saline springs owe their origin to the layers of rock-salt through which they pass, and which belong to a later formation, and are frequently surrounded by gypsum, lime, and clay. The process of solution, performed in the interior of the earth, is often artificially imitated in salt-works, for instance, in Ischl, (east of Salzburg,) where a cold sulphur spring arises, not far from the salt works.

The celebrated chalybeate of *Pyrmont* (this side of the Weser) contains comparatively little salt, though this abounds in its saline spring, in the immediate neighbourhood, clearly indicating a shallower origin.

The saline springs can be traced in the direction of the great layers of salt. The rich salt mines of Austria furnish us with Ischl, Reichenhall, Rosenheim (towards the west). The strata of salt near the shores of the Rhine, from Basel to Aix-la-Chapelle (west of Cologne), present us with Baden-Baden, Kreuznach, Wiesbaden, Soden, Nauheim, Schwalheim, Salzhausen, Burtscheid, &c.

From the Nether Rhine, considerable salt mines pursue an easterly direction towards the Weser and Elbe, giving rise to Œynhausen near Minden, Salzuffeln (below Eilsen), Sondershausen, on the Unstrut, Elmen (52° lat.), Halle (below Elmen, on the Saale), and Colberg on the Baltic Sea (east of the Isle of Rügen).

The springs of Schwalheim and Salzhausen show that the halopegæ may originate near peat-layers. No doubt some owe their origin to volcanic processes, as Wiesbaden, Baden-Baden, and Aix-la-Chapelle.

As regards the elevation of saline springs, you will observe that, though generally situated low, as in the north of Germany, they sometimes lie more than 1000 feet above the level of the sea, as in the Salzburg district and Tyrol. The salt spring of Chamossaire, near Bex (on the Rhone), is upwards of 3000 feet above the sea; Reichenhall and Hallein (in the neighbourhood of Salzburg), 1300; Halle on the Elster, 500; Colberg, near the sea.

Let us now consider *those springs penetrating into much greater depths, and less dependent on atmospheric or superficial influences.*

They arise out of primary transition or volcanic mountains. Compared with the above, their atoms are found in a more thorough and intimate combination; their temperature, quantity of water, and composition, are more constant.

The *thermal and acidulous springs* are of this order:—The volcanic processes in the interior of the earth drive mighty rocks of basalt out of the depth of the sea, inflaming strata of coals, inundating whole regions with lava and ignited substances, shaking the highest and firmest mountain ranges, and all this free from the various forces and elements acting in the atmosphere of the surface. Fire alone could not accomplish these processes without the cooperation of water.

The contact of the two powers, however, produces vapours, which, by expanding, burst the opposing layers of the earth and discharge streams of lava and of basalt.

If the vapours are pent up, earthquakes necessarily ensue. Should they however find no resistance, they form gaseous products and stream out as carbonic acid, sulphuretted hydrogen or nitrogen.

To these gaseous streams the thermal and acidulous springs seem to owe their origin.

The volcanic character is probable from their situation, being mostly near active or extinguished volcanoes. Vesuvius is surrounded by thermal springs. The mightiest volcanic mountain chains of Europe, in North Bohemia, on the Rhine, &c., are accompanied by powerful thermal and abundant acidulous springs.

A relation, no doubt, exists between earthquakes and Thermæ. It is asserted that those regions are less exposed to earthquakes which possess volcanic springs—for instance, North Bohemia, the Rhine, and Taunus regions. Such mountain chains, in which no eruption of lava, basalt, hot vapours, or carbonic acid, has taken place, are said to be more exposed to earthquakes. During the earthquake of Lisbon, that part built on limestone suffered more than the adjoining Belem, partly built on basalt.

Of all the earthquakes that took place in January and February, 1824, from the foot of the Saxon mountains to the Elnbogner-kreis (circle), only two German miles from Carlsbad, nothing was felt in Carlsbad itself. Springs that have flowed for centuries, suddenly stop under some distant volcanic revolution, cease flowing for years, and then as suddenly return, sometimes with changed temperature. This happened in Carlsbad in 1809, whilst an earthquake took place at Lisbon. The Schlossbrunnen disappeared, and returned in 1823 with a lower temperature.

Through the earthquake of 1692, the water of the Pouhon, one of the springs of Spa, near Liége, became clearer, of a stronger taste, and more abundant. Sometimes, however, earthquakes are only perceived in the environs of hot springs, whilst the flat country is spared.

During the earthquake, in the year 1768, the sulphurous therma of Baden, near Vienna, became violently agitated; rose a foot higher, and emitted a stronger smell of sulphur than usual.

Most remarkable, however, are the changes that took place on November 1, 1755, when one half of Lisbon was destroyed by an earthquake. Between eleven and twelve in the morning, the chief spring of Teplitz began to get turbid, and to discharge for a few minutes a dark, yellow liquid;

and after having ceased running a short time, it burst forth with such violence and abundance, that all the basins overflowed. At first it came out turbid and yellowish red, but regained its former transparency after about half an hour.

A few days later, on the 9th of November, in Canstadt (Wurtemberg), near the mineral springs, two such violent concussions took place, that an adjoining house sank several feet with a loud crash.

The hot springs generally arise out of granite, gneiss, and other volcanic kinds of mountain, frequently near basalt or transition rocks of analogous formation and composition, as porphyry, greenstone, and greywacke.

Directly out of gneiss, granite, and greywacke, or in their vicinity, arise the springs of Pfeffers, Leuk, and Bormio, in Switzerland, Warmbrunn, in Silesia, most of the hot springs of Hungary, Styria, Salzburg, &c.

Even when Thermæ seem to spring up out of strata of red sandstone or shell-lime, as happens in several springs of the Vosges, in the ramifications of the Black Forest, and the mountains of Northern Switzerland, this later formation only seems to form a sort of covering for the deeper primary mountain-masses.

The warm springs of Baden, near Vienna, arise out of tufaceous* lime.

The primary mountains do not seem, however, to be the proper focus of the thermæ, but rather a means of their connexion with the volcanic processes in the interior; for the springs mostly come to light in such regions, in which volcanic mountains are found near the primary.

In Sweden, with its prevalence of primitive rocks, not one considerable therma is found. At the northern declivity of the Alps, as in Baden, Wurtemberg, Bavaria, comparatively few hot springs are found, the greater number being on the southern.

Formed out of melted granite or analogous stones, and violently raised, like lava, from their subterranean volcanic birth-place by vapours, basaltic masses burst the crusts of different kinds of mountains, and frequently attend active or extinguished volcanoes. The warm springs of Bertrich arise out of greywacke slate, interspersed with lava and basalt; the thermæ of Aix-la-Chapelle out of greywacke. This connexion of thermal character with basaltic eruptions is clearly shown in the thermæ of North Bohemia, of the Taunus and Eifel mountains (near the Rhine).

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* Tufa is a clayey fossil, mostly porous, ashy gray, and consisting of loose particles of lime; its origin is volcanic.

As regards the cause of the inherent heat, curious notions were formerly entertained. Some explained it from a peculiar process of fermentation in the interior of the earth, others imagined that the springs came in contact with caustic lime, by which heat is produced; according to others, through the action of water on sulphur pyrites. Some ascribed it to subterranean conflagration of strata of coals or peat. It was more rationally assumed, that as the temperature lowers in proportion to the rarefaction of the air in ascending upwards from the surface, the temperature must become higher the deeper the earth is entered and the more the air is condensed.

Others maintained that a peculiar heat constantly exists in the centre of the earth, independent of extraneous influences. That the temperature rises in proportion to depth without reference to geographical latitude, or to season, is an acknowledged fact. The frequent presence of cold springs in the neighbourhood of hot, demonstrating the deep origin of the latter, has been already pointed out.

Let us now consider the *composition of the Thermæ*. Alkalies prevail with carbonic, hydrochloric, and sulphuric acid. The non-volcanic springs possess more earthy salts. Carbonate of soda is very frequently met with in volcanic mountain masses, as in klingstone, basalt, pearlstone, pumice, different kinds of lava, &c. Sometimes sublimated carbonate of soda is found in volcanic regions.

Sulphuric and hydrochloric acids are frequently found near volcanoes. The same holds good of carbonic acid, though it is sometimes difficult to determine whether its evolution is due to the action of heat or of a stronger acid, by which it may be expelled.

Hydrochloric acid gas escapes from Etna. The surface of the lava ejected from Vesuvius in 1794 was covered after a few days with crystals of chloride of sodium and hydrochlorate of ammonia. Chloride of sodium is the prevailing constituent of volcanic productions; the next is sulphate of lime, then sulphate of potash, then hydrochlorate of lime and of potash. Also the quantity of nitrogen found in several thermæ seems to refer to their volcanic origin, this gas being often met with in gaseous volcanic evolutions.

Potash is frequently found in volcanic mountains, and also in granite, mica, and other kinds of primary rocks. In a similar manner, the presence of lithia, manganese, and iron, can be explained, as also the phosphates and fluates.

The acidulous springs are also supposed to owe their origin to volcanic processes. Like *thermæ*, they appear in groups, following the tracks and ramifications of volcanic mountains. This is demonstrated by the Hungarian mountains abounding in thermal and acidulous springs.

The Riesengebirge and the mountains of the county of Glatz, have only two thermæ; but numerous anthrakokrenæ (cold acidulous springs). The same is the case with the mountains of North Bohemia, which form, as it were, one chain extending as far as the Rhine, Taunus and Eifel mountains.

Most anthrakokrenæ originate out of transition lime, variegated sandstone, clay slate, gneiss, greenstone, marl, and very frequently near basalt, and other volcanic products.

Their *temperature* is remarkable, from its stability being very slightly influenced by atmospheric changes, which shows them to possess a much deeper origin than common springs, and a great analogy to the characteristics of the thermæ.

In the Ragoczy spring of Kissingen, for instance, the temperature was + 5° R., when the thermometer stood at the freezing point; when in hot summer, the temperature rose + 32°, the spring had only + 9°. Thus the temperature of the spring, only changed 4° to 32° of the atmosphere.

As in the thermæ, their ingredients are most intimately combined, carbonic acid and soda being the media of solution. Even the proportionate quantity of solid ingredients is analogous to the thermæ. It is inconsiderable, when they arise in primary mountains. In both, soda is mostly present, with carbonic, sulphuric, or hydrochloric acid. The quantity of carbonic acid flowing out deserves particular attention.

This is explained by the mighty evolutions of gas, taking place periodically in volcanic eruptions, or appearing as results of continued volcanic processes in the interior. In Italy, this not only happens in the celebrated Grotto del Cane, but also in other parts of Naples and Sicily. Permanent evolutions of gas are also met with in the volcanic mountain ranges of the Rhine, especially of the Eifel, near Birresbronn; at Daun, near the shore of the lake of Laach, which furnishes by its environs unmistakeable proofs of a former active volcano; at Kissingen and its environs; in the neighbourhood of Pyrmont and Driburg; and near Franzensbad and Marienbad. The gas mostly consists of carbonic acid gas, but sometimes contains sulphuretted hydrogen, and nitrogen mixed, as in Marienbad, Franzensbad, in the Grotto del Cane, near Naples: the temperature of the gas naturally corresponding with that of the spring: the quantity somewhat depends on the pressure and temperature of the air, on its movement or quietude, or its electric condition.

The circumstance that carbonic acid gas may become liquid by high pressure, induces the belief that the gas may have originally existed in a liquid state, but become transformed into gas by its issue into the external regions, under diminished pressure.

A very important consideration in the choice of a spa is, further, the variation of the climate. Geographical latitude often fixes the character of a watering-place, though not invariably so. The more easterly or westerly position must also be looked upon as exerting some influence. Thus you find, under nearly the same latitude, *Wiesbaden*, which is renowned for its temperate and mild climate, and *Steben* on the Saale (tributary of the Elbe), and Alexandersbad (on the Main), known for the inclemency of their climate.

The quality of the ground, the nature of the surrounding mountains, the cultivation of the soil, standing or flowing waters, all exercise their influence. In spas surrounded by marshy fields or stagnant waters, intermittent fever is sometimes found endemic. How this injurious influence may be removed by proper cultivation is shown in Franzensbad, where intermittent fever was formerly endemic. But now, the marshy meadows and ponds having been dried up, this disease is very seldom met with, even in very hot weather.

The necessity of carefully inquiring into the condition and climatic properties of the environs of a spa, before you select it as the most eligible for a patient under your care, will thus be obvious to you.

LECTURE III.

GENTLEMEN,—The mysterious nature of these remarkable outpourings induced many persons to attribute accidental circumstances to their influence. Thus, for instance, the vapours arising out of the springs at Pfäfers were thought a preservative against the plague, because in 1611 and 1629, when the cantons of St. Gallen and Appenzell were devastated by the plague, all those that resided at the time in Pfäfers were spared. This, however, could not furnish a proof of the preserving power of the spa. The non-attack may have been due to the high and isolated situation of the place; being, perhaps, beyond the reach of atmospheric miasma. On the other hand, the salutary effect of sea air was well known and appreciated by the ancients. The cause is, no doubt, the diminished carbonic acid of the atmosphere, which is, besides, impregnated with saline exhalations. The same influence is also shown in the character of the surrounding vegetation. A favourable effect, similar to that of sea air, may be expected from the vicinity of salt and graduation works, for a considerable quantity of free hydrochloric acid has been found in the air near the salt-works of Halle. The same acid has also been detected in the rain water of Salzufeln (lat. 52° on the Weser).

If snow-covered mountain peaks are situated in the neighbourhood, the climate will be characterised by a certain bleakness, though the snow may be present only a part of the year.

This is, for instance, perceived in the spas at the foot of the Fichtelgebirge, Thüringer Forest, Erzgebirge and Black Forest.

The climate is further modified, according as the spa is situated on the southern declivity of the mountains, and thus protected against violent north and east winds, or on the northern declivity, just exposed to them.

Look at Wiesbaden, being on the southern declivity of the Taunus, below the reach of north and east winds, and enjoying an extremely pleasant and mild climate. Now, behold Schwalbach, only a few leagues to the north, unfavourably known for the bleakness and severity of its climate. What is the reason? It lies on the plateau of the mountain, and the same height that serves as protection to its fortunate neighbour, exposes it to the full attack of the north and east winds.

In Barèges, the celebrated French spa of the Pyrenees, the climate is so severe, that it cannot be well inhabited more than six months of the year, whilst in its neighbourhood mineral watering-places enjoy the most lovely climate. A still greater difference exists between the places lying north and south of the St. Bernardino.

Though in the northern situation the climate is very severe, on the southern, luxuriant meadows are seen at a height of 5000′. At Misox (4900′,) corn cultivation begins; at Soazzo (3000,) the vine is cultivated; and farther down fig and mulberry-trees flourish.

The circumstance whether the valley of the respective spas be narrow, encircled by steep and high cliffs, or broad and open, becomes of high importance; as, for instance, in diseases of the chest. The partial impediment to the entering rays of the sun causes the narrow valley to be comparatively colder and moister, and patients with weakened thoracic organs will feel oppressed by a long sojourn in it. Invalids of this description occasionally complain of a somewhat impeded respiration, even in the valley of the Tepl, at Carlsbad, or of the Lahn, at Ems. How oppressed and inconvenienced would these persons feel at Pfeffers, which, though it lies 2000′ above the level of the sea, is so enclosed by high and steep rocky mountains, that the beneficent influence of the sun is not admitted more than seven hours in the longest days. Thus, supposing the present disease should strongly mark out Pfeffers as the most appropriate spa, you must not send a sufferer there, if his thoracic organs are at all liable to irritation, or disposed to derangement.

The influence of the greater or smaller elevation I have already treated of. I have said that the purity and tenuity of the atmosphere belonging to high situations, possesses tonic and stimulating properties, whilst that of lower situations, being denser and impregnated with more impurities, must produce corresponding depression of the vital functions, or vitiate the circulating fluids, and thus lay the seed of actual disease.

You will have observed, Gentlemen, some analogy between acidulous and hot springs, as regards their volcanic origin. But you may further notice, that heat and carbonic acid seem respectively to perform the same function of solving and keeping the constituent particles in close union. When you hear on my treating specially of the waters, that a spa contains so much carbonic acid, it is of the utmost importance to inquire, whether the acid be intimately and firmly connected with the water, or whether it merely seems to stream through it, loosely attached.

Though in general 100 volumes of water absorb only 106 volumes of carbonic acid, we find the drinking spring of Pyrmont to contain in 100 cubic inches of water, 171 cubic inches of carbonic acid; the Franzensquelle, near Eger, 153 cubic inches; the Ferdinand's spring of Marienbad 145 cubic inches; in fact, a greatly varying amount, irrespective of what might have been imbibed under the ordinary atmospheric pressure.

In some instances, the quantity of volatile ingredients varies according to the electric tension of the atmosphere, or in consequence of unexplored processes in the interior. The cold sulphur spring of Günthersbad, near Stockhausen, in Thüringen, evolved during four months (from November, 1817, to February, 1818), a considerable quantity of sulphuretted hydrogen; suddenly the quantity diminished, and the water exhibited instead, a strong taste of iron. When the Ragoczy, of Kissingen, was cleaned out, a source of carbonic acid was found, with a varying quantity of gas. In June, previous to a tempest, at a temperature of + 22° Reaumur = $81\frac{1}{2}$ Fahrenheit, 170 cubic inches of carbonic acid flowed out in a minute. In July, during moist weather, and a temperature of + 14° Reaumur (= $63\frac{1}{2}$° Fahrenheit), only 110 cubic inches in the same period, and a day later 140 cubic inches. A similar variation of quantity has been observed in those grottoes in which a continuous evolution of carbonic acid takes place, as in the Grotto del Cane, near Naples, and the vapour cave near Pyrmont. As regards the quantity of ingredients dissolved in the springs, it does not invariably exceed that dissolved in common water; on the contrary, it is often smaller. What constitutes them *mineral waters, is their peculiar composition and distinguishing properties of taste, colour, temperature, and specific gravity*, *and, above all, their specific efficacy on the human organism.* Several drinking wells of Berlin, Stockholm, Hanau, and other towns, contain from five to ten grains of solid ingredients, dissolved in sixteen ounces, without claiming the character of mineral waters, whilst the powerful spa of Wildbad contains only $3\frac{1}{2}$ gr. in 16 ounces; Teplitz, $4\frac{3}{4}$; Gastein and Pfeffers, $2\frac{1}{2}$ gr.; Brückenau, 2 4-10; Spa, 3 3-10; the sulphur spring of Landeck, 2 6-10. Those which contain chlorides and sulphates have most ingredients. Amongst the German springs, Püllna possesses 182 gr. of solid ingredients in 16 ounces, Saidschutz, 160; Seidlitz, 126; the muriatico-saline spring of Pyrmont, 113; the Soolspring of Nenndorf, 93; Ragoczy, of Kissingen, 85; the sulphur spring near Doberan, 76; the Kreuzbrunnen of Marienbad, 66; the Kochbrunnen of Wiesbaden, 59 gr.

As regards the proportion of solid ingredients of sea water,—

The Mediterranean possesses in 10,000 parts	410	grains.
The English Channel	380	,,
The North Sea near the Isle of Föhr	345	,,
,, near Nordeney	342	,,
,, near Leith	312	,,
,, near Ritzebüttel...............	312	,,

The Baltic Sea near Apenrade	216	grains.
,, near Kiel	200	,,
,, near Doberan	168	,,
,, near Travemünde	176	,,
,, near Zoppot	76	,,
,, near Carlshamm	66	,,

When evolutions of carbonic acid or sulphuretted hydrogen overspread whole regions, the common sources are partially impregnated with the gas. But then it escapes very readily, causing iron or other ingredients, previously kept in solution, to precipitate. Thus in the steel-spring of *Bruckenau* the carbonic acid adheres less to the water than is the case in the neighbouring spring of Wernarz: a bottle was filled and left open the whole night, and still a considerable quantity of carbonic acid was found in it next morning. Again, in the chalybeate of Schwalbach, the wine-well possesses the carbonic acid in a more adherent state than the so-called Stahl-brunnen (steel-well). The mineral water of Steben, in Bavaria, after having been kept three years in a well-corked bottle, was still clear, transparent, and without the least sediment. Some of the chalybeo-sulphurous water of Bocklet was exposed for twenty-four hours in an open vessel to the influence of atmospheric air, and still no oxide of iron was precipitated, and when shaken, many gas bubbles were developed. Most of the Silesian and Glatzian acidulous springs have also their carbonic acid, but weakly adherent; and thus they would lose much of their character by being sent to some distance. (Niederlangenau and Obersalzbrunn appear to be excepted.) In the chalybeate of *Driburg* the gas adheres firmly. Pyrmont possesses a similar distinction. This is also the case in Selters-water, though the small quantity of iron it contains becomes easily precipitated. By a very intimate combination are further distinguished—Kissingen, Spa, Franzensbad, &c.

Even sulphuretted hydrogen, which is generally less firmly united with the water, on account of its lower specific gravity, varies as regards its adhesion in several springs. For this reason some powerful sulphurous waters have less sulphur precipitated, and cannot furnish, therefore, materials so appropriate for sulphur mud-baths, as weaker springs with more abundant precipitates.

If the hot mineral waters have lost their heat by exposure to the atmosphere, many of their combinations become disunited or deposited, and thus they generally lose their characteristics on being transported to a distance.

Cold sulphurous and acidulous springs are less easily decomposed; the former, however, will often undergo essential changes by the escape of sulphuretted hydrogen, and the latter by the evolution of carbonic acid, and consequent precipitation of previously dissolved particles.

The best adapted for distant carriage are waters abounding in soluble fixed salts, and comparatively deficient in volatile ingredients; for instance—bitter waters, saline waters, &c. Though the constituents of most springs are of inorganic character, some, undoubtedly, possess organic substances.

If you find yourselves near the Sprudel of Carlsbad, you perceive the same smell as if you were near a kitchen where soup is being boiled.

The water of Wiesbaden tastes just like weak chicken broth, somewhat over-salted; and if you closed your eyes in drinking it, you might really fancy yourselves taking broth. The assertion—that some analogy exists in this respect with organic fluids—seems thus somewhat confirmed.

This is further borne out by the easy assimilation of the respective hot waters, and by the stimulating and strengthening power, which they often exercise, though according to the character of the constituents, weakening or irritating effects ought to be expected.

As regards temperature of the water, we have not only to consider the reaction it creates in the human system, but its influence on the composition of the respective spas.

In cold springs the adhesion of carbonic acid becomes firmer, through cold, and thus the stimulating and invigorating property is increased.

By a very high temperature, gaseous constituents are volatilised it is true, but the fixed ingredients are the more firmly and intimately combined. From this reason, hot springs, though possessing a great proportion of weakening or lowering salts, do not produce debilitating effects, but are on the contrary well assimilated, without irritating the digestive canal, or depressing the vitality of the constitution.

As in the constituents, I pointed out the difference between loose and thorough combination, so in temperature, we have to remark the peculiarity of the inherent heat of the springs. It is, no doubt, of volcanic origin, and many experiments have been made to compare it with heat artificially produced. It was generally thought, that the natural springs possess a greater capacity for caloric, than the artificial ones heated to the same degree.

Some attempted to show, that heated waters, exposed to the atmosphere, lose their heat sooner than naturally hot springs. Others demonstrated the fallacy of these experiments, in which the same ingredients had not been added to the artificial water, as were contained in the natural. No difference was established in the time of cooling between the two, if the same solutions were contained in the artificially heated water, as in the natural thermæ.

Nevertheless we have a right to assume that the caloric produced by volcanic processes exerts a different influence on the human system than that which has been artificially produced.

It is true, if we observe the effect of a hot spring, we cannot well separate that part produced by temperature from that which the constituent particles may have contributed.

But, finding such strong efficacy in some thermal springs with scarcely any solid ingredients of importance, we are compelled to attribute a great portion of their powers to the peculiar inherent caloricity, unattainable by artificial means.

The different physical perception is apparent. Though the thermometer may indicate the same degree of heat, our feelings prompt us to consider it of a different kind. Let any one take a common warm bath at Wildbad, and then bathe in the mineral spring, he will find a certain degree of languor after the former, and even during immersion he will not find a comfort in staying longer than twenty or twenty-five minutes. How differently will he feel when he lies on the warm sand in the thermal bath. No shadow of oppression is produced by the heat; on the contrary, he feels lighter, more cheerful, and seems to breathe with greater freedom than before. Instead of a desire to leave after a short time, by a certain indefinable depression, arising from long exposure to heat, he rather feels more cheerful and gratified, and would stay for hours, if health would not be injured by it.

We certainly cannot prove by analysis the different character of this caloric: but can we analyze the rays of the sun? and still we see their necessity in the growth of plants. Withdraw these rays, the most blooming and beautiful specimens of the vegetable creation wither and decay. You provide a substitute by the hothouse; but do ever these hothouse plants perfectly resemble the natural ones? They sometimes exhibit a finer appearance, more beautiful colours, larger size; but will they ever be equal in intrinsic value? Will they give out the same odour? will they last the same length of time? Again, some thermal waters can be drunk without inconvenience, whilst a common beverage of the same thermometrical heat could not be taken with impunity.

May not we also attribute some importance to the circumstance, that, in a common bath, the different layers of water can scarcely be expected to have all the same degree of heat? The lower strata will always possess a slightly diminished warmth compared with the upper. Besides, how can the water be made to retain the same heat during the stay of the bather? If, on entering, he found the temperature exactly suitable, it must be less so after a few minutes. If, notwithstanding these disadvantages, warm baths are such useful, nay, indispensable, auxiliaries of medical treatment, what benefit may you not expect from the influence of this congenial warmth surrounding the body, in company with the involving liquid, gently stimulating the lymphatic and blood vessels to an increased function, promoting the exhaling power of the cutaneous pores, improving the secretions of the dermic follicles, soothing the morbid sensibility of the peripheric nervous ends, and imparting pliancy to rigid muscles?

The tendency of evaporating bodies to assume the gaseous form is called *tension,* and equals in power the pressure of one atmosphere at their boiling heat; viz., each liquid must be assumed to hold part of itself in a gaseous form, which escapes when absorbing greater heat. The expansive power of heat attenuates the circumambient air, and consequently diminishes its resistance and pressure. As soon, then, as the heat has been raised to such a degree that the impeding weight of the atmosphere has been sufficiently diminished, volatilization takes place. According to the stronger or weaker tension, the boiling point will be at a lower or higher degree of heat under the same atmospheric pressure: for you are aware, in a vacuum where the air is exhausted, water is made to boil considerably below the usual boiling heat. Besides its own gas, water also has the power of binding permanent gases without evolution of latent heat; that is, without increase of temperature, and consequently without diminution when the gas escapes.

This binding of permanent gases is called *solution.* It also depends on the quantity of water-vapour contained in the liquid. If you raise the temperature of the whole, the proportion of the absorbed foreign gases diminishes as the watery vapour increases, the expanding homogeneous gas filling out the atomic interstices, and thus expelling the foreign gas. A strong barometic pressure can cause more gas to be absorbed, but always in the same proportions.

Thus, 100 volumes of pure non-aerated water absorb 253 volumes of sulphuretted hydrogen; 106 of carbonic acid; 6½ of oxygen; 4 6-10ths hydrogen; 4 2-10ths of nitrogen.

As one volume of nitrogen corresponds with twenty-five volumes of carbonic acid, water saturated with carbonic acid and coming in contact with air, must expel twenty-five volumes of carbonic acid before it absorbs one volume of nitrogen; the acid escapes, therefore, the slower, the smaller its quantity is in the water; and when, already, other gases are dissolved in the water in their proper proportions. In consequence of this relation, water always absorbs comparatively more of the oxygen than of the nitrogen of the air, and whilst the proportion of the oxygen and nitrogen in the air is as 21 to 79, in water it is as 31 to 69.

The greater the specific gravity of water by the solution of solid ingredients, the less it is able to dissolve permanent gases.

For if solid bodies are dissolved in the water, the volume is not like the addition of both volumes, but the whole is proportionally diminished in volume. For instance, water in which $26\frac{1}{8}$ parts of salt are dissolved, should have a specific gravity of 1·150, if both volumes were simply added, but in reality, it weighs 1·200 at 15° Reaumur. What may be the reason of this curious contraction? Ought we not to suppose, on the contrary, that the solid body entering into a liquid state, would occupy a greater space than formerly, rather helping to enlarge than to diminish the volume of the former liquid? The reason is, no doubt, the escape of latent heat out of the water to combine with the liquefied solid, by which means the watery atoms must contract. From the same cause, they offer less surface to permanent gases, which might otherwise be retained in the atomic interstices.

The development of carbonic acid may be explained by the melting of basalts and cooling of lava masses. Many masses of lava and basalt contain carbonate of lime, which retains its carbonic acid when melted with other stones under strong pressure, giving it up, however, when it comes to light and is freed from pressure. The periodic evolutions of carbonic acid near volcanoes, are explained by this. These evolutions of gas belong to the transition mountains, and thus have a deep origin. The lime of basalt alone combined with $7\frac{1}{3}$ grains or $10\frac{2}{3}$ cubic inches of carbonic acid furnishes a sufficient quantity of carbonic acid for immense evolutions.

The exhalation of carbonic acid inducing thus a formation of volcanic masses, at the expense of carbonate of lime and other stones, has probably taken place with greater energy in former times. The atmosphere may thus have contained more carbonic acid, and great strata of coals may have been formed out of vegetables abounding in carbon, which had decomposed the carbonic acid of the air, furnishing the oxygen necessary for the life of warm-blooded animals.

Chemical affinity has also some influence on certain processes of its expulsion. Thus sulphuric acid forms gypsum out of lime, and bitter salt out of the domite.

Those atmospheric springs which contain carbonic acid, must have obtained it by the process of fermentation and vegetation in the external layers of the earth.

Now, Gentlemen, let us devote a few moments' consideration to the *medical effects of temperature.*

In our organism, not only must the temperature of the blood be created,but an excess of warmth, as a regulator of the circumambient temperature, either spreading to the surrounding colder media, or transforming the enclosed water into vapour, if the media approach our own heat. On this account we only feel at ease if moving in a lower temperature than that of our body. For though the excess of the generated heat would be consumed for some time in *perspiration,* the irritation of the peripheric nerves would ultimately be transferred to the central nervous system, causing over-stimulation, giddiness, head-aches, palpitation of the heart, fainting, &c., as results of the impeded escape of the regulating heat of our body. Clothes serve to prevent the too rapid escape of our internal caloric. The nature and form of the capillary vessels dispose them more to transmit animal heat to the exterior, than to spread external cold into the interior. Under the influence of a low temperature they contract their volume, condense their tissue, and close those openings of the secretory surfaces, in which the blood discharges part of its water in the form of liquid or gas. Thus, it requires the very highest degrees of cold to produce immediate paralysis of innervation and gangrenous congelation. In all minor degrees of cold, a reacting process takes place from the central nervous system, inducing increased heat on the surface, as soon as the refrigerating influence ceases. This differs materially in various organisms. An epidermis frequently exposed to cold ablutions, for instance, possesses a stronger degree of nutrition, a denser tissue, a steadier peripheric circulation, in vessels of larger calibre. We should call such a person obdurated, because his nervous system is less sensitive to external irritation, frequent reactions having produced greater firmness.

But when the excess of animal heat is rapidly absorbed by evaporation, the perspiratory canals being filled, the movement of the blood accelerated to supply the necessary quantity of liquid, and the action of the lungs and heart consequently increased: the blood becomes condensed and more inclined to obstructions, by being partly deprived of its serum. When in this state the external temperature suddenly lowers, demanding as sudden a withdrawal of internal heat, the superficial nerves become irritated, and necessarily impart this irritation to the central organs, producing congestion or inflammation, especially as the tide of circulation will flow more violently towards the interior.

The above will explain the great difference between the action of cold on a body heated by exercise, the cause of such manifold injuries, and the comparatively innocuous application of extreme cold, as cold douche, on a person, whose epidermis merely has been incited to increased heat by blankets, in a quiescent position, or by vapour baths. The violently irritated exhaling vessels are somewhat soothed by the sudden cold, and the calm function of internal organs the less indisposes them to participate in the effects of the sudden change, as the cold is not allowed to act long, so that reaction from the interior takes place, before the deprivation of heat can communicate lesion to the non-excited internal organs. The better a substance conducts heat, the sooner it withdraws our caloric, and the sooner it establishes an equilibrium. This circumstance causes metals to produce a sensation of more than thermometrical cold by contact.

The water having a much stronger conducting power than air, would withdraw our heat much quicker, and therefore the temperature of the atmosphere, in which we feel at ease, would cause an intense sensation of cold if it were imparted to water, in which we are immersed, the latter depriving us more quickly of our excess of caloric.

An extremely hot bath will induce at its first contact a passing sensation of *chilliness;* a very cold bath, of burning. How is this to be explained? I think in this way: the first *shock* of high temperature produces a sudden contraction of cutaneous pores, for it drives the water vapour surrounding the body, the result of inherent heat, as we have seen above, towards the interior, at its onset, till violent reaction ensues.

The first result of strong cold, however, is to cause a sudden escape of the excessive inherent heat in question, and thus momentaneous opening of the exhaling vessels, with a momentary sensation of burning.

The effects of baths on the epidermis, are in accordance with the horny character of the latter. Heat extends and swells it, and renders it more pliable; cold contracts it, and makes it more rigid. The highest and lowest temperature make it impenetrable for the exhaling substances, which therefore raises the cuticle in blisters.

The highest heat borne without injury is 36° Reaumur, = 113° Fahrenheit. The normal excess of caloric is not only prevented from further development, but a part of the hot medium is communicated to it; therefore, besides the local sensation of heat, general immoderate reaction ensues, circulation becomes increased, the central nervous system agitated, and particularly arterial functions heightened. These efforts may be required as curative in certain morbid affections, when the nervous centres are to be brought into action from their peripheric ends. By the softening of the horny substance, the excretory canals are contracted and closed at their external ends, and thus the subcutaneous watery vapour collects and causes tension of the epidermis, which becomes fragile in consequence, and desquamates sooner or later. The violent irritation may easily produce febrile action. Thus chilliness may arise with other characteristic phenomena.

Such elevated temperature may, therefore, be admissible in very few cases of general torpor, in certain spasmodic diseases, in fact, when a curative reaction is to be expected, or when this general external derivation is to be safely employed, to restore diminished cutaneous innervation. But they must be considered *as extremes* in extreme states; at least for the whole body; for in such general torpor some internal organ is mostly in a state of irritation, forbidding the employment of such a violent remedy; but in the shape of partial baths they may often be employed as excellent local derivatives.

Hot mineral waters create a somewhat less sensation of heat, because part of the caloric is required to keep the dissolved ingredients in a liquid state. This is particularly the case in mud-baths, in the so-called chalico (earthy) and theia (sulphurous) thermæ; less so in the alkaline or saline thermæ. In the latter, the irritation of heat is supplanted by the chemical stimulus of soda or chlorine, corresponding with the other stimulus at least in its secondary result.

Baths of a temperature between 20° and 30° Reaumur (77° and 100° Fahrenheit) would not produce any influence on the temperature of the organism if the animal heat had not the function of furnishing a regulating excess to the surrounding media. In some individuals this excess is very small, and would be withdrawn by a bath of 28° Reaumur. In others again of more robust and plethoric habit, this heat would produce effects described as appertaining to baths of 30° and 36° Reaumur.

In the lukewarm and cool bath, the warmth acts no longer as a stimulus inherent to the water. But the absorption of internal heat must influence those organs, which perform the function of calefaction. The amount of heat which each atom of water requires to put itself into equilibrium with the heat of the body, and the rising of the warmed layers from the surface of the body upwards must materially lower the amount of animal heat, and primarily depress the external innervation; but the consequent reaction induces a powerful impulse from the interior to the circumference, tending to an increased production of heat, and a heightened metamorphosis on the surface.

If the individual leaves a cold bath, the reaction produces such an excess of warmth as to guarantee a certain stability of external innervation and resistance to the changing temperature of the air (unless it be violently agitated). The air itself being a bad conductor, and requiring little latent heat for maintaining its gaseous form, does not deprive us of a great amount of warmth as already shown. The epidermic redness produced by a cold bath certainly resembles the visible effect of a hot one. But whilst the consequence of a hot bath is reaction to the interior, redness with congestive fulness of the epidermis, being the commencement of the phenomena, in a cold bath, external redness and increased circulation are the closing phenomena resulting from a reaction issuing out of the centre towards the exterior. The warm bath acts as a sudden excitant of functions, the cold as a sudden retarding influence. The individual organic resistance will decide whether the reaction will have a local or general character.

Suppose, for instance, the urinary organs to be in anirritated condition, a sudden immersion into a cold bath, which momentarily prevents perspiration, will produce increased urinary secretion, or spasms of the secreting organs. If mucous membranes are abnormally affected, over-stimulation and great irritation may ensue through the sudden action of cold. The functions of the muscles sometimes become insensible and immovable through this diminished innervation.

When increased calefaction takes place by some irritation of the peripheric nervous system, a cold bath will absorb this excess of heat, and violent reaction need not be apprehended, from the energy of the nervous system having been previously weakened through the over-stimulation. The cold bath will only be beneficial when its effects assume the type of fever—cold, warmth, increased secretions, &c.

The duration of the cold bath is of great importance. After the first effects of weakened innervation have been counteracted by reaction, the steady-heat absorbing-power begins to act. The general secondary reaction, beginning with rigors, will appear, sooner or later, according to the individual power of resistance.

Smaller quantities of water rapidly exchange their temperature for that of the blood. The evaporation consequent on the liquid applied always binds a certain amount of heat. Moist bodies under thick covering stimulate the cutaneous system to a greatly increased serous secretion. They act like a local vapour-bath, with this modification, that the body itself supplies the necessary warmth. Such moist applications and fomentations may be reckoned as powerful sudorifics, and might be very beneficially employed with sea or saline water in complaints characterised or produced by suppressed or retained perspiration, and by heightened nervous susceptibility to external influences.

Vapours can be employed in much higher temperature than water, being worse conductors, and possessing a smaller capacity for caloric. But you may ask, "Why should they be better borne than air?" The answer is very simple; because they require a great amount of heat to be kept in the gaseous form, which is not the case with the permanent gaseous mixture composing our atmosphere. They also less impede evaporation, in fact, promoting it. They are very useful where the liquefying process is to be heightened, where perspiration has been retarded, where noxious matters are to be excreted by the skin.

Careful experiments have shown beyond a doubt, that water and its constituents are absorbed by the body, whilst serous and other cutaneous excretions are dissolved and retained by the water. The continued action of the liquid exercises a peculiar stimulus on the sebaceous glands.

The vapour bath, however, exclusively promotes serous secretion, and wants the primary stimulus of external innervation.

The inhaled vapours gently promote the flux of blood to the mucous membranes; but, being charged with moisture, they exert a relaxing and softening influence, resisting local contractions and obstructions. Whilst, therefore, they are injurious in deeper affections of the pulmonary tissue, their employment is attended with advantage in passive chronic irritation of the mucous membrane of the lungs.

The greatest utility of the vapour bath is shown in rheumatic paralysis, produced by suppressed cutaneous function, when we require the smallest amount of local irritation with the highest degree of general evaporation.

The characteristic effect of *warmth in the digestive canal*, is *pure stimulation* of the nerves of the alimentary tube, without secondary peculiarity.

After the application of this stimulus, circulation becomes slightly accelerated, the pulse fuller, perspiration and urinary secretion increased, and with this the effect closes. If the external temperature be low, the production of an excess of warmth is favoured.

Sometimes the stimulus of a hot beverage causes heightened action and over-stimulation, and in consequence antiperistaltic motion or obstruction. Bile and gastric juice are mostly caused to flow with greater abundance.

If internal organs are in a state of irritation, hot drinks are liable to produce violent hæmorrhage, plethora of the brain, headache, giddiness, oppression of the chest, &c.

This congestion to vital organs may be prevented either by keeping off all external influences that might impart cold to the body (for instance, by the patient remaining in bed, and being induced to perspire while using the hot beverage) or setting the muscular system in action by gentle exercise, thus promoting general circulation as a derivative from locally irritated tissues.

Cold, applied internally, produces greater power of irritability, by the reaction which ensues.

If acid gastric juice is secreted to excess, or if venous circulation be retarded by the extended, slowly moving blood-vessels, or if abnormal innervation occasions anti-peristaltic motion (that is, vomiting), *cold* will prove highly useful.

As regards the mechanical effects of water, some persons lay stress on the increased pressure, water being much heavier than air. But if this exercised a great influence, there ought to be different effects on various parts of the body from the unequally distributed pressure. If a person stands in water up to his neck, the weight is considerably greater on the lower than on the upper part of his body, and the circulation might be pressed upwards, and may be the cause of some persons feeling a sort of oppression when entering a bath. As a general rule, however, less importance is to be attached to this than to the movement of the water, either by suddenly falling on the patient as douches, or by steadily touching and receding from the bather, as the wavy motion of sea-baths, which are so eminently useful by inducing muscular re-action and counter-movement, vastly superior to any gymnastic contrivances, connected with violent exertion or agitation.

The muscles of the neck and chest being particularly exposed to this increased action, their organic innervation becomes strengthened, and with it the tone of the thoracic organs. On that account sea-baths are so eminently useful in strengthening the lungs, and in preventing, to a great extent, development of tuberculosis and other pulmonary diseases, where tendency to such diseases exists.

The douche acts through its violent shock, according to its height, as a more or less exciting local agent. The shower-bath produces a sort of titillation of the peripheric nerves, and thus diminishes excessive nervous sensibility.

As regards the *imbibution of the constituents,* we must bear in mind that organic cells and tissues have sometimes more attraction for one combination than for another, and thus prevent sometimes the purely chemical influence. For instance, *hydrochlorate of ammonia* produces, in large doses, giddiness, and stupefaction, momentary obscurity of sight. Similar results will follow the administration of *carbonate of ammonia,* when only the fourth part of the former be taken. Nevertheless, you may give carbonate of magnesia and hydrochlorate of ammonia at the same time, and you will merely perceive the action of hydrochlorate of ammonia, though, according to chemical laws, carbonate of ammonia ought to be formed immediately after their introduction.

Some constituents of the mineral waters no doubt possess a restorative power, supplying substances requisite for the proper performance of organic functions; others cause chemical action by displacing particles without undergoing changes themselves. This is called *catalytical power,* from κατὰ, below, afterwards, and λύω, to solve.

Whilst αναλύω means *to solve backwards,* that is, to separate the elements, as they may have existed before their combination, καταλύω means to solve out, or turn out, as it were, a substance previously present. Most spas possess, therefore, the character of *alteratives* by reason of their ingredients. If, for instance, the same spring diminishes the irritation of the vesical mucous membrane and impedes the deposition of tubercular matter into the tissue of the lungs, whilst it exerts a beneficial influence in gout, these effects are attributed to the carbonate of soda and chloride of sodium, remedies which peculiarly counteract morbid acidification, or increased coagulability of the albumen.

I shall now bring to your notice the classification adopted by Vetter, who divides all the mineral waters into two large classes, viz., *Akratopegæ* (from *α* negativum, κρατος power, and πηγη spring), such springs which have as it were powerless constituents, though their efficacy may be highly potent, and *synkratopegæ* (from συν with, κρατος power, and πηγη spring), such mineral waters in which the power of the constituents to a certain measure corresponds with the observed effect.

We shall first occupy ourselves with the waters belonging to the former class, also called 'chemically indifferent.' They are clear, tasteless, and generally inodorous (sometimes weakly giving out the smell of sulphuretted hydrogen), of nearly the same specific gravity as water, and containing in sixteen ounces less than five grains of solid ingredients, and not above the tenth part of the quantity of gas which would correspond to their tension. The constituents are not such as exhibit strong effect in small quantities.

These are subdivided into :—

Akratothermæ, chemically pure thermal springs, as Gastein, Landeck, Pfeffers, Teplitz, Warmbrunn, Wildbad, &c.

Akratokrenæ, chemically pure cold springs.

The akratopegæ arise out of primitive mountains or such as are composed of little soluble fossils; they are alkaline or earthy, deficient in gas, with the exception of nitrogen or sulphuretted hydrogen. The more water approaches chemical purity, the greater is its latent heat; therefore they stimulate more than common baths of the same temperature. Their power of solving animal evaporation and of entering the peripheric vessels is likewise greater, therefore active crises may ensue. They are particularly useful, where earthy formations prevail, or are deposited in tissues from a deficient power of transforming them into secretions, and from diminished circulation. On this account they are especially adapted to old age, affording the so-called yóuth-restoring power, by increasing the strength of innervation, and the pliancy of the limbs affected by rigidity and weakness.

With this lecture, Gentlemen, the general* part of our subject closes, and at our next interview I shall have the pleasure of directing your attention to *Wildbad*, the celebrated Akratotherma of the Black Forest.

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* With the exception of the chemical portion, which I have placed at the end for facility of reference.

LECTURE IV.

WILDBAD.

GENTLEMEN,—To proceed to Wildbad, in Würtemberg, lat. 49, long. 8, we have first to reach Frankfurt, which we can do from London in about forty-four hours; thence the railroad takes us through Darmstadt, Heidelberg, to Durlach, near Karlsruhe, in about five hours. From *here* we travel by diligence through Pforzheim, and arrive, after about seven hours more, at our place of destination. Supposing you start from London on Saturday evening, you will reach Frankfurt on Monday morning, and Durlach the same afternoon. Then you might pass the night at Karlsruhe, the capital of the Grand Duchy of Baden, and avail yourselves of the diligence from that town next morning. This route will appear rather tortuous; and you may ask, why should we not retain our railroad seats as far as Baden-Baden, which lies in a due westerly direction from the spa, and is considerably nearer than the place I recommend for changing the swiftness of the steam-power for the well-known slowness of the so-called "Eilwagen," which means haste-carriage?

If you possess the means of having a private carriage, or the resolution to walk, you would certainly be amply rewarded for any trouble or expense by the beautiful, picturesque, and romantic varieties of scenery you will meet at every step in wending your way from the charming and fashionable Baden-Baden, the so-called Queen of the German spas, to her unpretending mountainous neighbour, who is content with merely attracting *real* sufferers from all parts of the globe, when human knowledge has endeavoured in vain to procure relief. To Her Majesty he ungrudgingly leaves all those visitors who desire to blend enjoyment and luxury with some advantageous influences on health.

The distance from Baden-Baden is about thirty English miles. The road rises more and more, and offers a sombre appearance by reason of the forest of pine-trees you will have to pass. After having allowed yourselves to enjoy the views and prospects of the surrounding peaks and mountains from the acclivities you have had to mount, you will descend a winding road to the town of Gernsbach, in the valley of the Murg, to the east; you then ascend to the village of Laffenau; you wind your path downwards again to Herrenalb, encircled by majestic mountains. Turning to your left, you perceive curious groups of basaltic rocks, with the appearance of a fortress. Ascending, you reach a plateau, which continues for six or seven miles, and offers extensive prospects towards the north-west. After passing a deep wood, you descend to the town of Neuenburg, on the Enz, north of Wildbad, in a narrow valley. From here you pursue the ascending course of the river for eight miles on the right bank, and you will find yourselves in the valley of Wildbad, about 1300 feet above the level of the sea, whilst the mountains reach on each side the height of 1500 feet. The fall of the Enz during this short distance is 370 feet. You see the course of the river to be from south to north, consequently the spa is exposed to these two winds, while it enjoys mountainous protection at the east and west.

Cold naturally prevails in its climate, snow not leaving the summits of the mountains from November till May. The heat is correspondingly great in June, July, and August. The reason of my generally indicating the ordinary direct route, is to put you into the same position as if you had personally inspected the several spas, so that you are enabled to point out to your patients, both the remedy and the best means of attaining it. The noble receives this latter information from his courier and numerous guides; the pedestrian from his brother foot-passengers. I need not tell you as regards Wildbad, that the road is nearer still, if you walk through the fields and valleys straight from Baden-Baden to the east, as is often done by the inhabitants of the environs. The town of Wildbad lies eleven leagues* (thirty-three miles) to the west of Stuttgart, and has about 1800 inhabitants. Karlsruhe lies at a distance of nine leagues to the north, Calw four leagues to the east, Pforzheim six leagues to the north-east. The wild and picturesque character of the environs is well worthy of admiration by those who delight in contemplating the beauties of nature. An early walk along the river Enz, which rushes with violence through the spa, led to the following notes in my journal, which I beg leave to quote; for they best show the momentary impression that was created at the time, though they might be criticised by persons who merely expect a drily detailed description. I wrote—"I cannot imagine anything more romantic and delightful—though shallow and narrow, the river foams and hisses, so that you might suppose yourself near the sea-shore. On both sides rise the mountains, covered with beautiful fir and pine-trees, of every variety of green. Particularly charming appear the rays of the sun, when they begin to force their way over the peaks of the eastern mountain to gild the yellow waves of the furious little river." By reason of the almost perpendicular acclivity of the enclosing mountains, the beneficent influence of the sun is obtained an hour later from the east, and departs an hour sooner in the west, than on the surrounding localities. The spa enjoys the reputation of great antiquity; and in the beginning of the sixteenth century its curative powers were already extolled. A remarkable charter was given to the place by Charles V.; viz., "that all criminals, with the exception of murderers and highway robbers, should enjoy here peace and liberty for a year and a day." The surrounding mountains consist of ferruginous red sandstone and granite. The springs flow out of cleft granite rocks of a gray, granular character, in four divisions from north to south, forming several independent basins. The springs vary in temperature from $25\frac{1}{2}°$ to 30° Reaumur (from 88° to 99° Fahrenheit). The largest bathing space, also enclosing the warmest springs, is called 'Herrenbad,' which means Gentlemen's Bath. On the left is observed a niche, which reaches to a considerable distance into the wall, and is called the 'Hölle,' being the hottest spot, out of which the chief source originates. By boards the basin is separated from another bathing space, called 'Bürgerbad' (citizens' bath). Then there is a space called 'Fürstenbad' (princes' bath); and another called 'Frauenbad' (ladies' bath). The bottom of the baths is covered with sand; and it excites extremely pleasurable sensations to move along on the warm sand, and dig it up with the fingers, causing bubbles of gas to rise to the surface. The temperature of the water being identical with that of blood, neither heating nor cooling is required to adapt it for use. This circumstance must be considered as highly advantageous. Another point of great importance is the constant influx and efflux of the same water, with unvaried temperature and constituents, which would be positively unobtainable by any artificial contrivance. You see the water bubbling up from several holes in the sand, which impart a greater perception of warmth to the hand held over them than the more distant parts. You may thus consider that the natural stimulus of this congenial heat, instead of performing a continuous action of the organism, rather divides itself into repeated and constantly renewed stimulating forces. The extent of the basins allowing muscular movement, compensates in some measure for the disadvantages of bathing in common (with separation of sexes) which is generally practised here. The water is let off every night, the sides are cleaned, and the sand is levelled. Before using the baths, the visitor is enjoined to take a common warm bath, preparatory to reposing on the soft bed of sand. According to the susceptibility and complaint of the patient, the warmer or cooler baths are chosen. A peculiar feeling of comfort and general ease spreads over the bather. Refreshed and invigorated you will certainly feel on leaving the bath, with increased cheerfulness and desire for exercise, and with improved appetite. During the course of the baths, however, a sort of reaction sometimes appears, ushered in by unexpected lassitude, depression, headache, general languor, loss of appetite, frequent feeling of chilliness, with subsequent heat and other signs of feverish action. Pains of rheumatism, gout, or of wounds, sometimes momentarily reappear, after having been dormant for a long period. These ought not to discourage the sufferer; on the contrary, they are signs of peculiar power exercised on the affected organs. The apparent systemmicic counteraction will only assist the efficiency of the spa. With properly regulated precautions the course can be continued as soon as the signs of febrile reaction, or bath eruption, in very susceptible individuals, have passed away. On the other hand, this must not be looked for as an indispensable condition of cure. Patients sometimes are gradually relieved and cured of obstinate chronic diseases without these rebellious symptoms. This chiefly depends on individual idiosyncrasy. I can conceive the baths benefiting one individual by the titillating contact with the sentient extremities of the nerves, generally stimulating the cutaneous function, and indirectly promoting the secreting power of vascular and sero-fibrous organs, by which effete and stagnant deposits may be carried off to make room for healthier products, whilst in another this effect is not produced till the vascular system has been put into a more or less violent commotion, whereby a new abnormal state has been created, to serve as a desirable crisis. In case the water should be entirely inappropriate, of course, Nature will give us distinct signs of her ungracious reception of the remedy, and these must not be disregarded on any account. But in this respect it shares the fate of every curative agent. I shall, therefore, allude only to such cases in which this or any other spa has been carefully selected, with a proper regard not only to the disease itself, but to all those secondary circumstances mentioned in my preliminary lectures.

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* League, the German 'Stund,' or hour, signifies such a distance as might be walked in an hour; it corresponds to about three English miles. A geographical German mile is rather less than two leagues or 'Stunden,' and equal to about five English miles.

The constituents of the spring are, in sixteen ounces:—

Chloride of sodium	1·82
Carbonate of soda	0·53
„ lime	0·34
„ magnesia	0·07
„ iron	0·02
„ manganese	0·02
Sulphate of soda	0·40
„ potash	0·02
Silex	0·39
Total	3·61

The gas dissolved in the water contains, in 100 parts:—

12½	carbonic acid.
79¼	nitrogen.
8¼	oxygen.

The gas evolved from the water, however, consists, in 100 parts, of—

2·00	carbonic acid.
91·56	nitrogen.
6·54	oxygen.

Formerly the baths only were employed; but since 1836, a drinking spring has been discovered, which is also made use of, and greatly assists the efficiency of the external treatment. Its constituents, to the amount of 4¼ grains in sixteen ounces, resemble very much the former, with, however, a little more silex, carbonate of lime, and carbonate of soda. The water is perfectly clear, tasteless, and of 1·004 specific gravity. To give you some idea of its quality, I have prepared an imitation. Its temperature is exactly that of the spa. The external properties of the respective springs will perhaps be better impressed on your memory if you examine them individually by your senses. Let us employ the ordinary tests. You see that it contains little free acid; in fact, only the fiftieth part of the gas evolved is carbonic acid. *Lime-water* causes therefore a very slight turbidity. Tincture of logwood shows no reaction. *Chloride of barium* produces some precipitate, consequently sulphuric acid is present (nearly ½ a grain of sulphate of soda).

Again, you see a precipitate formed by *nitrate of silver;* this shows the presence of *chlorine* (chloride of sodium is the chief ingredient, nearly two grains being present). You see that nitric acid does not dissolve the precipitate, whilst *ammonia* renders the solution perfectly clear again. *Oxalate of ammonia* informs you of the presence of lime; by the turbidity you perceive the presence of (about one-third of a grain of) carbonate of lime. You employ *basic phosphate of ammonia,* and find no double salt of ammonia-magnesia to be precipitated (there is no perceptible quantity of magnesia). You obtain a slight turbidity by caustic alkali (there being such a small quantity of salts of earths and metals). No precipitate follows the employment of carbonate of potash (the salts of earths present must have no other but carbonic acid in their combination). No reaction follows the employment of ferro-cyanide of potassium, nor that of ferrid-cyanide (consequently there is no perceptible quantity of iron present). Tincture of *galls* shows merely the presence of alkalies. The absence of iron is further confirmed by *hydro-sulphate* of ammonia causing no change in the solution. You see, then, that the water is indeed 'chemically indifferent,' as the springs of this class are sometimes termed, though I shall prefer adopting the term 'akratic,' which at once tells us that we have not to expect medicinal power from the constituents. What does then produce these beneficial changes to which I have already alluded? Some have ascribed all efficacy to the inherent caloric, which bears greater analogy to our blood than the same temperature artificially produced. Its vitality is no more insisted upon, as it was in former times. But it is maintained, that the chemical purity imparts to the water a more solvent power on animal exhalations. It may enter the peripheric vessels more easily, and cause absorption and excretion of earthy deposits in the tissues, previously stagnant, from a deficient plasticity, and from diminished circulation, as so often happens in real and premature old age. To all the 'akratic' spas, the common property of 'Verjüngen' (youth-restoring), is attributed. Some explain the restored pliancy and diminished rigidity of the limbs by the kind of soap that may be formed between the alkalies contained in the water, and the oleaginous evaporation of the epidermis. This imaginary soap thoroughly rinses the ends of the excretory dermic follicles by increasing their function; and freeing the system of effete animal matter, it communicates a stimulus to organic metamorphosis.

Admitting a more unrestrained entrance of the water into the peripheric vessels, we are perhaps justified in assuming, that the small quantity of ingredients being constantly renewed and in motion, the power of penetrating to the assimilative organs must increase with the quantity of water brought in contact with the body. Have we not a right to believe that more chloride of sodium, for instance, is imbibed by a person exposed to the action of this water for a certain time (though less than two grains are contained in sixteen ounces), than by another individual who bathes for the same length of time in water with 400 grains of the same salt in sixteen ounces?

The latter liquid being considerably denser, not only charged with the great amount of the dissolved ingredients, but actually of a less volume than pure water, of course penetrates with more difficulty. In fact, the beneficial results produced by such water are more sought in the stimulus exercised by the irritating power of the particles, than by their actual combination with the organic fluids. This view will also explain the reason why those springs standing between the akratic and synkratic are the least powerful. They are not diluted enough to enter the absorbent vessels so freely, nor are the constituents sufficiently strong to produce the stimulating effect of the more highly charged waters. I have then a right to attribute part of the utility of Wildbad to the chloride of sodium it contains, whilst I need not be refuted by the minor efficacy of the neighbouring Baden-Baden, which contains a greater amount of the same ingredient.

All along, Gentlemen, I have endeavoured to impress the conviction on your minds, that we must not merely look on the quantity of gaseous and solid ingredients, but on their more or less intimate combination or intrinsic adherence to the water, and particularly on the manner of their reception by our organism.

Do we not meet this difference daily in common life? We call an individual badly nourished, though the most substantial diet may regularly be brought into his stomach, while another has all the appearance of being well fed, and still you may find that he does not introduce the tenth part of nutriment into his intestines. Even in the very same individual the same food produces a different impression and different digestive results, according to the period of ingestion. And it is not a question with me what a person takes within the twenty-four hours, but at what periods.

For instance, I have frequently convinced myself, and particularly during the prevalence of cholera, that substantial food is more easily dissolved and assimilated if ingested four or five hours after a light breakfast, that is, in the middle of the day, than towards the close of the ordinary time of business. The reason is obvious: after you have quite shaken off the fettering weight of slumber, and roused fresh action by a warm stimulating drink, body and mind feel the greatest vigour, which increases towards the end of the morning. In the afternoon, retrogression of animal power takes place. Towards the evening you feel incapacitated from performing considerable mental or bodily labour, independent of the work carried on during the day. Then, I ask, is it possible that, whilst all organs open to our perception appear exhausted and debilitated, the stomach, our most hard-working servant, should contract with the same vigour and excrete gastric juice of the same strength and solvent power, as it would have done towards the end of morning? Reason says, it is impossible, and daily facts prove the impossibility. I have frequently asked *commercial* gentlemen, who merely take a biscuit in the middle of the day, whether they would feel distressed by waiting for their evening dinner half an hour or an hour later, than they have usually taken it for years? The answer is invariably in the negative.

The craving for the ordinary meal, felt by those who take their chief food in the middle of the day, if they have to wait a short period beyond their ordinary time, is quite unknown to the former. Is not this the best proof of the want of nature being strongest at that particular period, because she is then most able to perform this function? It is an undoubted fact, and often observed by me, that *cæteris paribus*, the want of an evening meal is considerably stronger after a substantial mid-day dinner, than after a mere appetite-deluding biscuit, because, in the latter instance, the stomach has become too much weakened for energetic action. I must also mention, that I have found malt liquor to have a much better effect on digestion with the mid-day, than with the evening meal. With dyspeptic persons the latter meal is better digested without liquid. How is this to be explained? The very same view will show, that the concentrated and stronger gastric juice of the early part of the day bears dilution and is, perhaps, benefited by it, whilst the weaker juice, a product of exhausted digestive organs, is impeded in its function by a greater dilution. If from all the above it is perfectly clear that such a great assimilative difference is produced in the same individual, without reference to the similarity of ingested quantity, I have a greater right partly to refer the differing results of the various spas to their modified assimilation. Perhaps you will allow me to bring a case under your notice, which strongly bears on the above question. One Sunday evening I was summoned to the house of a foreign family, where I found the lady writhing in gastric pains. Finding on examination that she only suffered from spasms of the stomach, I minutely inquired, whether she had taken anything indigestible, or whether she had been exposed to cold? I was informed that she had lived that day as usual, found herself perfectly well and cheerful till four o'clock, when she sat down to dinner and took a small piece of fowl. An hour afterwards she was seized with these excruciating pains. No question nor cross-examination could elicit any fault of diet to have originated the complaint. The patient was between thirty and thirty-five years of age, very robust, and an apparent picture of health. Last year she was affected with cholera, and ever since her digestion and general nervous power had become weakened. An attack like the present had recurred already five or six times before, at intervals of a few weeks, and the family had begun to exhibit great anxiety, seeing these frequent returns with greater and greater violence. The attacks very easily yielded to simple treatment. Once I gave *tinct. valer. ammon.* with *liq. op.* On another occasion, *pil. galban. comp.* with *extr. hyoscyam.;* on the same evening *hydrarg. chlor.* gr. v., with a quarter of a grain of opium; and relief invariably ensued. But the task was now to prevent these distressing fits. By renewed examination next day, I learned that the lady had taken a soft egg and some toast at eleven, A.M., of which I was not informed the previous night, this being considered too innocent to have any possible connexion with the complaint.

On asking whether she could not take an earlier dinner about one, and avoid lunching, I was told that she always felt so faint and hungry between eleven and twelve o'clock, as to be obliged to take some nourishment. Be it understood, that for years she had lived in the same manner without the slightest inconvenience; but since her digestion had become impaired, I explained the constant recurrence of the above attacks from her taking a second meal before the first was properly digested. I therefore enjoined her chief meal to be taken for some period at the time she was in the habit of lunching, viz., between eleven and twelve, and tea four or five hours afterwards, with some slight digestible food, if prompted by a strong appetite. I promised a non-return of the fits, if she merely followed this instruction; and without medicinal assistance, my prediction has been completely verified. Her digestion and strength improve daily, and no trace of these attacks has recurred now within several months.

I hope the great and often unappreciated importance of the point I have discussed, will serve as an apology for this digression from our spa, to which we will now return.

Every bathing space has a depth of water of one foot eight inches. Smooth stones are placed in several parts, to enable the bather to sit in a greater or smaller depth of water. Narrow basins adjoin the larger spaces for a small number of persons, or for single baths. The rooms for dressing are conveniently arranged and warm. The action of the water stimulates the vascular, while it calms and strengthens the nervous system. The function of the absorbent vessels increases, secretions are promoted, and the nerves regain previously diminished activity. The uterine nervous system is very favourably influenced by the water. The chief indications are *gout, rheumatism, arthritic paralysis, and contractions from wounds.* Unfortunately, or shall I say fortunately, these very diseases are likewise cured by the other three akratic spas, viz., Pfäfers, Gastein, and Teplitz; some by the halotherma of Wiesbaden; and the difficult question is therefore as yet generally undecided, what forms of the above-named diseases are especially claimed by each spa? I may as well tell you, that till now these four spas have been used almost indiscriminately for the same diseases, and the choice was often more due to accident or local acquaintance, than to any difference of properties; you will find arthritic, rheumatic, paralytic, and traumatic patients at each of them; and still there are great differences in their properties and corresponding differences of effects. To arrive at a satisfactory solution of this problem, I made the chief task of my journey last year. It was painful to witness at every watering-place, individuals who were cured of their complaints by the spas, but who constantly declaimed against their medical advisers, for not having chosen this place in the first instance, instead of having previously sent them to several others, where they had found no relief. I thought what a great benefit it would confer on the suffering portion of mankind, if every physician who had the opportunity, would do his utmost to determine and fix the accurate indication of each spa, and prevent these sad exhibitions of patients wandering from place to place, whilst a careful consideration might at first have chosen the appropriate remedy. Geheimerath *Dr. Fricker* recommends it in rheumatism, after the acute stage has passed, in gout with concretions, in neuralgic pains, in chronic diseases of the uropoietic system, as cramps, vesical hæmorrhoids, in retained and enclosed foreign substances, in contractions and stiffness produced by scars, in paralysis resulting from apoplexy, in hysteria and retarded menstruation. The water taken internally, is said to promote the action of the liver and kidneys, and gently to increase alvine evacuation. *Dr. Schweickle* found the spa particularly efficacious, also, in atonic ulcers of the legs, in induration of the mammary glands, in hemiplegia after typhoid fevers, &c.

Now, Gentlemen, I do not doubt that these diseases may have been cured under the influence of Wildbad; but the question with us must be, 'in what derangements does it afford us the *best chance* of a cure among all the other spas?' *Dr. Fallati,* whom I mention as last, but certainly not least, considers Wildbad very beneficial in such forms of *gout* and *rheumatism,* in which digestion is not impaired (should dyspepsia be present, the disease will, according to him, get worse); also in such paralysis, gout, and contractions after wounds as are connected with considerable deposits and swelling; in fact, *whenever absorption* is to be *produced.* The spa is particularly useful when the disease has shown previous tendency to amelioration. In hysteria, and diseases of the bones, he also finds it beneficial. In chlorosis and ulcers he would not recommend it. There is one point almost invariably remarked by the patients, as if by mutual agreement, viz., *that their limbs become more flexible.* Wildbad should therefore be chosen for such cases of *arthritic paralysis* as are based on *articular swellings* or other material cause, when increased absorption forms the chief indication. Dr. Fallati finds the efficacy increase in a direct ratio with the length of stay in the bath; this would strengthen the view, of remedial imbibition helping towards the favourable result. I must not forget to mention the beautiful contrivance at Wildbad, by which the patients are let down by machinery from their rooms to the baths without requiring any stairs, (it resembles that constructed in the Colosseum). On the ground-floor their chairs are rolled on a sort of wooden railroad to the respective baths. Paralytic and otherwise disabled persons form the greatest number of invalids.

Wildbad is *contra*-indicated in plethora, tendency to congestion, to apoplexy, to active hæmorrhages, in inflammation, and internal ulceration, in fever, &c., in fact, whenever acute disease demands a prompter treatment.

There is an establishment of whey at the place, which is, in many instances, advantageously employed.

Allow me to draw your attention, for a moment, to the gaseous contents of Wildbad. You perceive no glairine nor baregine amongst the solid constituents, but is there not a certain substitute to be sought in the great quantity of nitrogen present? No importance is generally attached to the circumstance, because, forsooth, we live in and constantly inhale azote. How, then, can we expect medicinal results from such an ordinary substance? But, Gentlemen, how different is the effect of the element when entering the lungs as a mere emollient and companion of oxygen, returning unchanged and unabsorbed to the external world as soon as it has safely delivered the indispensable vivifying agent, oxygen, to the circulating fluid; how different, I say, from its ingestion into the alimentary canal, where it furnishes an indispensable agent for the maintenance of life?

It is true, the gas is only known from its negative properties. But, Gentlemen, ought we not to seek in it some great and powerful connexion with vitality, if we find its combination with hydrogen to be the most stimulating, reviving, and reanimating substance that can possibly be taken (viz., ammonia NH_3)? We should imagine the combination of oxygen with the same element must be a more inciting and vitality-restoring agent; but, in fact, it is the most neutral substance imaginable, viz., water.

Whilst oxygen is necessary to keep the organic machinery in motion and to circulate vital caloric through all our tissues, forming, as it were, the oil of our living flame, azote is, on the other hand, equally indispensable to restore wasted tissues and fluids. Without the former we should suffocate, without the latter starve. I should not go so far as to attribute a nourishing property to the azote introduced into the absorbent vessels with the highly-diluted water. But when it is admitted, on all hands, that our tissues constantly discharge wasted particles in proportion to the regular additions provided by the arterial supplies, and when we know a great part of this waste to issue from our cutaneous pores in a gaseous form, would it not be reasonable to attribute some restoratory function to the contact and combination of the gas with organic particles? We know that, in old age, earthy or inorganic formations prevail in the reproductive sphere. Limbs become more rigid, the joints less pliable, secretions retarded, excretions diminished, vital elasticity and resisting power impaired. Substances ordinarily carried rapidly along the vascular canals in a dissolved state, are now precipitated out of the slowly moving mass, and deposited in spaces where they further impede voluntary movement.

If we see the use of a mineral water, causing distinct retrogression of these anti-vital phenomena; if we perceive gouty concretions to proceed towards absorption; if we observe contracted limbs gradually to relax again, and to try feeble efforts of long-forgotten exercise; if we find cutaneous harshness and rigidity to diminish, and to give way to a former softness; if we behold a resuscitated desire for muscular exertion and for mental work in a prostrate individual, and we know the spa, the originator of these changes, to possess a great quantity of azote, is it not legitimate to attribute to this gas part of the efficacy?

Whilst the chloride of sodium exercises its well-known beneficial influence on organic metamorphosis, stimulating digestion by forming hydrochloric acid on the one hand, and combining with albumen as soda on the other, counteracting earthy formations, azote may powerfully assist this process, and contribute towards the curative changes.

A highly-respected physician of Munich, Dr. Öttinger, who visited Wildbad last year, and who of course can have no interest in propagating its fame, expressed himself in these enthusiastic terms:—

'Wildbad, July, 1850.—The first month of the season has already passed, and furnished very happy results. Prince T—— could only walk with difficulty on sticks, and was oppressed by physical and mental suffering: now cheerful and restored, he departs with grateful recollections out of the healing valley of the Enz.

'Many other visitors exchange their crutches for sticks, and walk about without further support. Several persons, bent down by spinal suffering, are daily enabled to approach more the erect posture. Paralytics, who had been unable to leave their beds for years, descend after three or four weeks' course from their garden-chairs, and try the former habitual step with a satisfactory result. But Wildbad must not be thought as affording exclusive aid to the disabled. Deeply seated internal diseases sometimes are checked here, and become retrogressive, or cured. An emaciated person with impaired digestion, through a gastric ulcer, increases in corpulence and is able to perform digestion, after a four weeks' course. Another required the daily application of a catheter for two years, in consequence of an arthritic affection of the bladder, and after the sixth bath he can already dispense with that assistance.

'We have personally witnessed these results, and received confirmation out of the mouths of the respective visitors. The fair sex is very numerously represented here, seeking and finding relief from their protean nervous complaints: 1000 guests may be accommodated at a time. The apartments are good; some very elegant; the arrangements for bathing excellent in every respect. The douche is extremely well understood, and managed with highly satisfactory results. Few thermæ offer the complex advantages of a water with the most appropriate temperature analogous to that of blood, receiving the bather immediately in the bubbling sources, without conducting pipes, without the artificial aid of heat or cold, and thus without volatilisation of its gaseous constituents. Wildbad has been too little appreciated by physicians. The unfortunate term 'indifferent' therma, seems to have served as a privilege to cease exploring either its chemical ingredients or its comprehensive and energetic medicinal efficacy.

'Though no more salts are contained in this therma than in common drinking water, this very circumstance might serve to cause a more intense penetration into the organic tissues. The fact that retrogression of disease and even cure have ensued in incipient spinal softening, in gastric ulcers, in swelling of the uterus and ovaries, in chronic catarrh of the larynx and trachea, &c., justifies the above assertion.

'When larger sums have been devoted to the scientific examination of its imponderable gaseous constituents, and particularly of nitrogen, the most powerful agent of this therma, the spa will be properly appreciated and more frequently recommended. This year's season will be a brilliant one: as a non-resident and unprejudiced observer, I do not think I make too bold a prediction, if I prognosticate for Wildbad, that by the aid of further progress in science and medicine the period will come when this therma will receive a more determined and well-defined position among therapeutic agents. Then it will not merely be resorted to in such internal diseases as resist pharmaceutical remedies, or where clear indications are wanting. This spring, bubbling out of numerous holes, will then no more be designated as 'indifferent,' but as decidedly and sovereignly efficacious.'

A case of paralysis of the lower extremities, produced by a severe delivery, came under my notice, which was completely cured at Wildbad during the season. Another case was reported to me of a horse-dealer, who was squeezed between two wagons, and lost 'the use of his legs' in consequence. He also found a complete cure in the healing source of Wildbad. But in these instances the spa was chiefly chosen from its being the nearest akratotherma; and if a more distant spring of the same class is resorted to, this generally takes place after an ineffectual employment of the neighbouring water. In England, however, where these local considerations lose their importance, it behoves us to recommend to our patients in every instance the one spa which will afford them the greatest chance of relief or cure. I have to add, that the accommodation afforded by the little town of the Black Forest does not reach the luxurious scale maintained at some other more brilliant spas. But real invalids, merely seeking the restoration of their health, will meet here with every requisite convenience and comfort at comparatively moderate charges.

LECTURE V.

PFÄFERS.

GENTLEMEN,—Having left Wildbad at half-past nine A.M., the *diligence* arrived at Stuttgardt in eight hours. The road, as far as Calw, is extremely picturesque. It rises constantly, lined on both sides with charming forests. The carriage passes for some time along the brink of a ravine, (separated from the high road by stones,) down which the timid can scarcely look without a shudder. From Calw to Stuttgardt, the prospect becomes more ordinary. From Stuttgardt we proceed by railroad to *Canstadt* (about four English miles distant), situated on the right bank of the Neckar, which here becomes navigable. The town contains upwards of 4000 inhabitants, and is connected with Stuttgardt by a handsome park, through which a carriage-road passes. On the 'Wiesenplan,' in the south-eastern part of the town, a rural festival is celebrated every year, on the 28th of September, which is visited by an immense concourse of the surrounding country people. The environs abound in petrifactions. The elevation of Canstadt above the level of the sea is 600 feet. The climate is mild, the environs fertile and well cultivated, abounding in wine and fruit, and are called by some 'the garden of Suabia.' The mineral springs originate from a ferruginous lime-tufa, superposed by strata of clay and slate. They belong to the class of *saline chalybeates*.

The temperature is 15° to 16° Reaumur, summer and winter. The water is clear, sparkling, and has a saltish piquant taste. That of the *Sulzerainquelle* tastes more agreeably than the others, and exhibits 'Sprudel' properties, its supply increasing and diminishing periodically. It contains about 39 grains of solid constituents in 16 ounces, viz., 17½ of chloride of sodium, ½ a grain of chloride of magnesium, 10 grains of sulphate of lime, 2 of sulphate of soda, 1-5th of sulphate of magnesia, ⅓ of sulphate of potash, nearly 6 of carbonate of lime, 1 of carbonate of magnesia, less than 1-10th of carbonate of iron, carbonic acid gas 21 cubic inches. Temperature 15½° Reaumur. The other springs are very similarly constituted. The 'Wiesenquelle' contains ¼ of a grain of iron. Besides the above, I will merely mention '*Die obere Sulz,*' a small pond, occupying about a quarter of an acre, and formed by several confluent springs. The surface is constantly covered by gas-bubbles arising out of the depth, and consisting of carbonic acid and nitrogen gas. Temperature 16° Reaumur. The water deposits a great deal of mud, and seems to be in constant motion. Its amount of carbonate of iron is ¼ of a grain. There is an ascending douche, very advantageously employed in catarrhal affections of the vagina and rectum; also a whey establishment. The water is considered as tonic and solvent. The well-known *orthopædic* institution of Dr. Heine is well worthy a visit. It is built near the 'Frösnerische Bad.' In the 'obere Sulz,' near the gardens of the establishment, the orthopædic patients are enabled by certain contrivances to bathe in the pond at a temperature of 16° to 17° Reaumur: artificial waves are produced by wheels, to increase the stimulating and tonic effects of the baths. Mud—douche—rain—and shower baths are likewise administered. I would further allude to Dr. Veiel's establishment for herpetic diseases, which annually increases in reputation, and in which artificial baths, river baths, with strong afflux, are used with considerable advantage. But, Gentlemen, I have given these details merely on account of the importance to be attached to Canstadt, from its neighbourhood to the great spa we have just left. If you proceed from Stuttgardt by railroad at eight in the morning, without stopping, south-east as far as Ulm on the Danube, and then pursue a due southern course, slightly bending westward, you reach Friedrichshafen, on the Boden-see (Lake of Constance) in $7\frac{1}{2}$ hours, that is, at half-past three P.M. The steam-boat waiting for the trains starts half an hour afterwards, as soon as it has received the passengers and cargo destined to cross the 'Boden-see.' I find in my journal the following remarks:—

'The view on the lake is most delightful, and particularly striking. Whilst hitherto the various modifications of forests, hills, and mountains exhibited their beautiful trees and luxuriant foliage, here nature displays charms of a differing kind. The lake presents a green surface, gently moved by slight undulations. On the sides, masses of snow are perceived with the naked eye, covering the peaks of the glaciers in the midst of summer. There is something in this peculiarly awful, denoting the inscrutable greatness that must have pervaded the creative Spirit, which presided at the formation of the earth. The gentle movements of the vessel cause a rather agreeable sensation, and do not prevent writing on the open deck in this charming weather. But in storms the boats are said to be tossed about, as if shaken by sea-waves. The Wurtemberg railroad appears extremely well managed, and really fulfils the purpose of not only forwarding the hurrying passengers with considerable speed, but actually encouraging traffic by the pleasure it communicates. Every seat affords as much comfort as can possibly be accumulated without identification with the next higher one. The greatest punctuality is observed in starting and arriving. The carriages of the second and third class are so contrived as to give them the appearance of a company assembled on rows of benches in a drawing-room, with an open passage in the centre for the officers and travellers. If, while sitting at one end you see an acquaintance at the other, nothing prevents your walking up and sitting by him, while the carriage is in motion. At every station the name and exact time of stopping is called out. As soon as the train begins to move again, an officer walks through the passage and asks for the tickets of those who have to leave at the next station. Not only is a saving of time thus effected, but the possibility of travellers passing their place of destination is obviated. The great civility of every officer, not only to those of the first class, but to the humblest passenger, is too well known to be dwelt upon. This plan of railroad management is general in Germany, not only to the great benefit of the public, but of the railroad treasury.'

I beg forgiveness for this digression; but it is such an important subject for spa visitors, and all those who seek pleasure or instruction in Germany, that I could not resist expatiating on its conveniences, with the lurking hope, that the simple contrivances of the continent might perhaps find introduction here.

The steamboat lands the passengers on the opposite shore at *Rorschach* in about an hour and a half. The diligence starts half an hour after your arrival, that is, at six P.M., and takes you within eight hours through mountainous roads, with an occasional peep at the infant Rhine, past Rheineck, Altstätten, and Sargans, to Ragaz, which lies at the foot of Pfäfers. You arrive at two o'clock in the morning at the post-office, hotel, and bath-house, which are all comprised in one building. The place is comparatively new; the baths are supplied from the chief spring of Pfäfers, and resemble the latter in every respect but temperature, which is here 27° to 28° Reaumur. The view on both sides of the house is very pleasant, though not to be compared with that of PFÄFERS itself, to reach which, you ascend a winding rugged path along the *Tamina*,* which rushes by in the depth with a continuous hissing noise, and with the greatest vehemence. On both sides rocky mountains rise almost perpendicularly to a height of 600 feet. The view is most romantic, but becomes truly awful and sublime, when, arrived *at Pfäfers*, you are led by curiosity to pursue the Tamina along the narrow, wooden path erected between the rocks and leading *to the three sources* from which all the baths are supplied. To quote from my journal:—'The rocks here are not only perpendicular, but actually bend towards each other, scarcely admitting the rays of the sun, and presenting cracks, fissures, and promontories, which fill the wanderer with awe. Treading cautiously along, and admiring this wonderful greatness of God's creation, which raises such an insignificant little rivulet into a powerful roaring mass, rushing along in the ravine under our feet, and filling with humbleness and timidity the boldest heart; we entered the enclosure of the chief source after about ten minutes, and found it filled with vapour. By means of a light, after a few minutes, we could perceive objects in the disappearing darkness, and we gazed down the cleft, whence the steaming fluid streamed out. Bathed in violent perspiration, we issued, ascending with care and a considerable degree of danger, eight or ten irregular steps, to examine the second and third sources, though these two are not used for the baths, and run down the precipice into the Tamina.'

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* Arises in the south and enters the Rhine towards the north, after a short but rapid course.

Pfäfers, lat. 47, long. 10 (Favières, Fabariæ aquæ), is situated in the canton of St. Gallen, in Switzerland. The lake of Wallenstedt is invisible to the north-west, and the town of Chur (Coire) to the south-east. The principal road leads from Ragaz, up a considerable acclivity, and then again by a steep descent into the valley, through the village of Valens. This road is about five miles in length, and is generally chosen for descending, whilst the path described above is more than two miles shorter, and usually serves to bring the visitors to the remarkable bathing-place. The necessaries of life are partly dragged to it by the former road, and partly drawn into the bath by cranes from the high rocky wall of the convent, to which the place formerly belonged.

The walks must naturally be limited. They are terraces which appear spirally ascending over each other, leading to greater and greater heights as you ascend the successive eminences. At a short distance, however, walks of a very charming character may be found by ascending the former convent and wandering through its environs. The Galanda, the Valens mountains, with the so-called Grauhörner (grey horns), rise to upwards of 7000 feet, and offer the most variegated tints and contrasts of forests and rocks, of mountain-meadows and snow-fields, of woods and plains, furnishing an *ensemble* of the most sublime and picturesque description.

The rocks from which the springs originate are composed of black limestone, interspersed with veins of white fluor-spar. Formerly the bath-house stood in the grotto of the chief spring. It was erected on beams that were driven into the rocks overhanging the yawning abyss. The patients were let down with cords from the heights of the surrounding cliffs, for a week's course.

Now, human industry has provided a more convenient approach to this remarkable spa, hidden at a height of more than 2000 feet above the level of the sea, at the foot of the Galanda on the south-eastern boundary of the canton of St. Gallen.

The river Tamina separates Hof-Ragaz from the village of Ragaz, where two highroads meet.

You see the route from the Zurich and Wallenstedt lake, as well as that from the Lake of Constance, leading through Ragaz and Chur towards Italy.

If you take a survey of the valley at Hof-Ragaz, you perceive on your right the little town of Meienfield, the Luciensteig (summit), with the towering Falknis, on the left the woody declivities extending to the small town of Sargans (north of the spa), over which the Gonzen, the Allvier, and the Kuhfirsten rise, while the youthful Rhine winds through the extensive plain.

The mountain scenery disclosed on ascending the valley of Pfäfers, is very grand.

Having ascended for about an hour, and reached the convent and village of Pfäfers, you see the mountain valley extending southward to the Kunkels pass and the Kalfeus valley.

To the west rise the Valens Alps, with their ragged summits; to the south-east, the proud Galanda. Near the village of Vättis, the Tamina valley assumes a more westerly direction towards the declivity of the high Ringel, and extends to the *Scheibe,* which rises to a height of 10,000 feet, and forms the centre of the cantons Glarus, in the west, St. Gallen, in the north, and Graubünden, in the south. From the Scheibe the Sardonen glaciers descend into the Kalfeus valley; and from these the Tamina rushes down and flows for about twenty-five miles, fed on both sides by frequent water-falls. In one of its most awful depths, the thermal healing spring comes to light, and is conducted to a somewhat more open and lighter spot on the other side of the river to the bath buildings, erected on the rocks, and confined by the foaming Tamina on one side, and by the steep overhanging declivity on the other.

The walk to the spring is now less dangerous than formerly, having been provided with balustrades, and somewhat enlarged. You start from the drinking saloon, and pass over the Tamina bridge, through a rocky vault, till you reach a little closed gate.

If you take a survey here, you perceive on the right the overhanging rocks; on the left, dark mountain masses covered with the light foliage of maple and beech trees; at your feet, the hissing Tamina; and in the fore-ground, the bath establishment. In the back-ground is the perspective of the widened gap, sparely illuminated by peeping rays of the sun. On boards, supported by beams, which are wedged into the rocks in a surprising manner, you walk a distance of 1500 feet. The side rocks are 200 feet high, and at the part where they approach each other, reach 290 feet. The light gradually assumes grayer tints; the moisture and coolness perceived, as you advance, further increase the gloominess of the scene. Under that part where the rocks almost unite, a remarkable marble grotto is pointed out, 35 feet broad, and 34 feet high. It lies on the left of the Tamina, and was built some hundred years ago for devotional purposes. After this the rocks open again, and you soon approach the vapour-cave, where the chief spring issues out of clefts in a grotto hewn in the rocks.

Fissures of the Kalfeus mountains, over the crest of which the Tamina rushes, are probably filled by water from the mountain heights of Galanda. Being closed in winter, they receive no more influx and therefore cease to supply the spring. The water contained in the subterranean canals then sinks deeper, and the veins of the upper springs begin to vanish, the lowest springs flowing the longest.

The baths are not floored here with sand, but formed in separate basins paved with marble, the water constantly running in and out. Cooling is performed by opening doors and windows and turning the cock off, from which the water runs. The natural temperature of 29° 97′ is lowered according to circumstances to 28°, 27°, or 26° Reaumur. Persons, particularly of the environs, sometimes remain for hours in the baths, even of the higher temperature, with very favourable results.

The water of Ragaz has lost one degree of Reaumur by its journey from Pfäfers: all the other arrangements are analogous with the parent spa. The *douche ascendante* is employed with great advantage to assist the course. Though the diminished heat cannot make a difference, for, as I mentioned above, the baths are generally taken at an equally low temperature in both places, I must not conceal from you the fact, that Pfäfers with all its inconveniences and limitations, stands in higher reputation with the profession and the public than the pleasant and commodious Ragaz, which lies about 600 feet lower, but offers the same water to the valetudinarian.

It is positively thought less efficacious; and this opinion cannot originate in medical rivalry; for *Dr. Kaiser, senior,* resides at Ragaz, whilst his son, *Dr. Kaiser, jun.,* gives his professional services at Pfäfers, and consults with his father in all cases of difficulty or danger. The argument that the rumour might proceed from fancy does not hold good here; for people would not come hundreds and hundreds of miles to imprison themselves for three or four weeks in a confined locality, which never enjoys the congenial influence of the sun more than seven hours a day, if powerful and decisive facts did not furnish a positive inducement. What then is the hidden influence residing in the parent baths, and failing in the filial branch? Is it the greater height of the former? Ragaz lies about 400 feet higher than Wildbad, and still it is thought of inferior efficacy, while Pfäfers is maintained by many to surpass the spa of the Black Forest in power. Let us well consider the facts before us, and endeavour to extract a theory from them. It is a remarkable coincidence in the three chief akratic spas, viz.—Wildbad, Pfäfers, and Gastein, that the locality of each is confined, and the air consequently impeded in its circulation. But there is another coincidence, viz., in each of the three a violent and foaming mountain torrent rushes through the spa with great fury. A third coincidence consists between the two latter, that of having a new establishment at a more convenient lower locality, receiving the same spring at a diminished temperature. And there is this fourth similarity, that the parent establishments are positively pronounced of considerably greater efficacy.

You will often hear in the common walks of life, even in this stupendous London, that individuals who have enjoyed for years excellent health, in the circumscribed space of the city for instance, have found their health impaired after they had exchanged their 'unhealthy' quarter for a more salubrious residence. Such complaints I am occasionally destined to hear myself, after my advice of choosing the open suburbs for habitation has been followed. How is this? Can we not reckon on increased vitality and lengthened life, if we flee from all the injurious exhalations and other dangerous influences, produced by congregated crowds of human beings? Do we not feel more cheerful, more vigorous, more conscious of our individuality, as soon as we begin to breathe the purer air of the charming fields, that a kind Providence spreads out for our use? Physiology promises greater vitality, our sensations confirm the promise, and still, how can we reconcile these contradictory facts? Though, as a general rule, we might continue to advise healthy persons to seek a freer habitation, circumstances must occur, in which the latter is actually more injurious. Does nature wish us to inhale as much oxygen as possible? If so, she would not present to our respiratory organs one part of this respirable gas with four parts of the involving irrespirable nitrogen. What do we see in animals that inhale pure oxygen? They live more intensely; all their functions are heightened; but, as an unavoidable consequence, the organs lose sooner the blessing of life. In the same way with many persons, country residence may cause greater vitality, and more intense organic action; but the question is, does not the stronger exertion lead to a quicker exhaustion? I would not receive as an objection, the longevity of farmers, who have spent their whole lives in this bracing and pure atmosphere. But we all know, how injurious strong contrasts are to health. And the most zealous advocate of temperance will not advise an habitual indulger in spirits to deprive himself suddenly of the usual beverage. If, then, a person has for a long series of years performed the respiratory function under the emollient action of confined space, he will not, without danger, suddenly imbibe the pure, but more exciting gaseous mixture. Many a dormant morbid diathesis may, and does develope itself into disease, and there is no doubt, that many a life would have been prolonged, by remaining in a less open situation. A case just occurs to my mind of a gentleman, who has the misfortune of an organic impediment to respiration, in a bent spine. For some years he resided at Clapham, and always suffered with a more or less violent catarrhal affection of the lungs. I advised him to remove to the city, near his place of business. For about ten months past, he has lived in an airy and commodious house in the same street in which he has to transact business during the day, and he feels himself positively healthier, and his thoracic organs stronger. Some influence is, no doubt, also to be ascribed to his more regular mode of living now. Of course, stagnant waters, or other injurious evaporations are hurtful to the immediate neighbourhood. From the above, I wish to conclude, that the very limitation of the locality may act healingly in some measure. What patients have we before us? Mostly those in whom nervous power is diminished, perhaps of certain parts only. Vicious metamorphic action has taken place. Substances, which should remain dissolved in the circulating liquid, have been separated and deposited in the joints, whilst others that ought to have been secreted, have been retained. Before desiring a stronger vital action to proceed from the circulating organs, by which oxidation and abnormal separation might increase, we may wish for a somewhat limited respiratory and oxydising action, so as to leave freer scope to the penetrating warm liquid from without, for inducing mobility of the stagnant particles, or for rousing the torpid and weakened peripheric nerves. When this is accomplished, bracing atmospheric influence will be useful in carrying to a successful issue the commenced curative process. The inconvenience that might possibly result from the greater pressure or confinement of the air, may be thought to find a certain corrective in the violent fall of the respective rivers, which, through the vigour of their movements, attract atmospheric impurities with more energy, and impart more freshness to the circumambient air, than they would without this rapidity.

The chief indication for Pfäfers, is *real nervous paralysis*, through wounds or apoplexy; or *paralytic gout, not based on articular swelling:* the power of the peripheric nervous system is distinctly raised by the spa, and more so than at Wildbad, though at the latter, absorption and resolution of swellings, is better performed.

The temperature of the chief spring is 30° Reaumur = 100 Fahrenheit; the deepest spring has 30½° Reaumur at its issue; the water is clear, tasteless, and inodorous. Sp. grav., 10,003; a small quantity of bath-glue is found of a yellowish colour, and unctuous to the touch.

Analysis shows 2½ gr. of solid ingredients in sixteen ounces, viz.:—

Carbonate of magnesia	0·87	about 4-5ths.
„ lime	0·32	„ 2-5ths.
Sulphate of soda	0·62	„ 3-5ths.
„ lime	0·37	„ 1-3rd.
Chloride of sodium	0·21	„ 1-5th.
„ magnesium	0·16	„ 1-5th.
Total	2·55,	with a very minute quantity of iron.

Gaseous contents:—oxygen	1·3	cubic inch.
nitrogen	3·7	„
carbonic acid	4·15	„

The bath-glue is composed of silex, carbonate of lime and magnesia, of argilla, and of oxide of iron. Internally and externally, the water has a stimulating, solvent, and, at the same time, strengthening and antispasmodic effect on the peripheric nervous, and on the vascular system, counteracting venosity of the portal system, and therefore removing obstructions. In spasms, paralysis, and neuralgia, a marked sedative power is exhibited.

Paracelsus, who visited the spa about 300 years ago, expresses himself thus on its caloric:—'You are aware that heat may have a various entity in itself. The heat of the sun is one, that of dung is another; a different heat, again, is that of burning wood, but much is wrought here by the innate warmth, that may be familiarly compared with human nature. What great things are performed by congenial heat is shown by the hens brooding their young ones with it, also as silk worms are bred by such warmth. Thus knowing that such an incorporated heat exists here, Pfäfers would surpass analogous *simplicia,* in which the warmth does not exist.'

Hufeland says of Pfäfers:—'Of all thermal springs, Pfäfers, in Switzerland, contains the smallest quantity of perceptible ingredients. The water tastes and smells like common water, and, nevertheless, it exhibits an efficacy which surpasses the most powerful spas. In this very year a striking instance has occurred to me. A man, who has long been affected with hypochondriasis, and retarded alvine evacuations, and who had used alternately several spas without effect, even requiring other remedies to strengthen the efficacy, went last year (1825) to Pfäfers; and scarcely had he used the waters two days, when every morning alvine evacuation regularly ensued after drinking a few glasses. His bodily and mental condition visibly improved, and he felt a freedom and mobility in his whole being unknown to him for many years; and, notwithstanding his sojourn in a deep mountain fissure, which only admits light for a few hours a day, he experienced constant alacrity and cheerfulness.'

The spa showed itself efficacious, according to Dr. Kaiser, in dyspepsia, flatulence, acidity and mucosity of the stomach, especially in *gastric cramps,* through repression of piles, of exanthemata, or of gout, in habitual diarrhœa, or obstruction, in abdominal plethora, &c.

Next, in diseases of the nervous system: hypochondriasis and hysteria, if based on suppressed action of the ganglionic system; if the organs below the diaphragm are impeded in their oxydation and decarbonization by arterial blood, to the disturbance of the vegetative nervous sphere, the diluted warm liquid penetrates to them, and induces a more vigorous transformation, and subsequently, a restoration of the previous equilibrium.

Metastatic gout, particularly in nervous, irritable subjects, and neuralgic pains of the face, are relieved here; also abnormal catamenial flow becomes regulated, &c. &c.

But, as I stated above, the chief reputation of the spa is in *paralysis,* contractions, and local weakness from wounds; but there must be no residue of apoplexia or congestion to the brain, else the spa would be injurious. The paralyzed part must not be too emaciated, nor quite insensible, else the so-called 'Ausbade kur' might be required, which consists in persons remaining longer and longer in the baths every day, till several hours' stay, for a consecutive series of days, has produced violent reaction.

Dr. Kaiser, Jun., showed me a very interesting case of a young man, twenty-one years of age, who was precipitated, about twelve years ago, from a hay waggon, on his head, and the load itself pushed upon him. He became unconscious. A concussion of the cervical vertebræ appeared to have taken place; still he could perform light work for a year with no other morbid phenomena than a stiff neck. After the lapse of this period his right hand began to become paralysed, and some time afterwards the right leg. The left arm and left leg followed in succession; so that, for several years, he was neither able to sit nor stand; urine also was discharged involuntarily, and stool could be promoted only by the strongest purgatives. Artificial sulphur baths and strychnine had been employed without advantage. In this state, he arrived on August 3, 1840, in the establishment for indigent patients at Pfäfers. He had to be carried into the bath, and held there by an assistant. Nevertheless, he received two baths daily, so that he used fifty within a month. At the same time, he drank thermal water, *ad libitum.* Amelioration was inconsiderable; only the fingers could be moved a little more easily; the digestion showed slight amelioration, the general nutrition being strengthened by wine and substantial diet. Soon after the course a bath eruption showed itself, when he had arrived at his home, and, from this critical phenomenon, marked retrogression of his evil began to show itself. In January, 1841, he could move hands and feet, and felt more sensibility in his whole body. In May, he could walk about in the room with two assistants. From June 5th, he repeated a four weeks' course, with frequent douches on the cervical and dorsal vertebræ. On the 18th day of the course he could walk alone with a stick before the 'Curhaus.' He left the establishment, with the direction to return after a month's repose, and repeat the course. This was done from the 13th of August. In the summer of 1842, he availed himself again of Pfäfers, and continued to do so in successive years, getting gradually, but steadily, better. To-day he can walk perfectly well, without the assistance even of a stick. I examined the patient myself, and the manner in which he described his gradual progress, how he could use one limb and then another, and how he began to sit without assistance, leaves no doubt that his cure from traumatic paralysis, in consequence of pressure or lesion of the spine, is solely due to Pfäfers.

The so-called youth-restoring property is attributed to the Spa, in a high degree. Individuals of eighty years of age, suffering from *marasmus*, are said to have been relieved from their great weakness, and considerably strengthened and refreshed by the course. Pfäfers is *injurious* in real plethora, in congestion to the head or brain, in active hæmorrhage, in phthisis, in diseases of decomposition, as dropsy, in internal suppuration, in general emaciation, &c.

The constituents being less even than in Wildbad, only 2½ grains in 16 ounces, of course no influence is attributed to their action, nor would I recommend them, *à priori*, for the treatment of disease, being possessed of little power in so small a quantity. But, Gentlemen, whilst the knowledge of our materia medica would not justify me in choosing these few grains of magnesia, lime, and soda, with carbonic, sulphuric, and hydrochloric acids, for certain diseases presented to me, I feel it, on the other hand, my duty to seek a rational explanation of facts recorded and acknowledged for several hundred years.

If these pure thermal springs *merely* acted through their inherent caloric, then, why should there be such a great difference in the species of diseases cured at each? Examine the facts to which I have directed your attention. Whilst in most diseases claiming cure at Wildbad, absorption of effete and stagnant deposits performs the chief part, corresponding with the previously mentioned solvent power of chloride of sodium, and assisted by the imbibition of nitrogen counteracting the prevalent inorganic earthy formation, you see here the chief ingredient to be *carbonate of magnesia and of lime,* with *sulphate of soda*. Taken internally, in great quantities, and brought into a very lengthened contact with the cutaneous pores, externally, the magnesia might not be imbibed in a sufficient amount to exert its antacid properties, but it may exert a greatly sedative influence on the nervous system in conjunction with the gently stimulating warm fluid, which rouses the peripheric nervous ends into renewed function.

The lime may partly assist this anti-spasmodic action, and partly enter into combination with the weakened osseous system, allowing a greater degree of exertion and imparting more stability to the articular movements.

The sulphate of soda may assist in gently promoting the intestinal function, and act as a sort of derivative from the affected nervous system. Join with this the influence of the peculiar atmospheric character, incidental to the locality, and we may conceive how this *ensemble* has produced the changes brought to our notice. This view is confirmed by the great utility of the water in the form of clysters in obstinate alvine obstruction, abdominal infarcta, suppressed hæmorrhoids, &c.; also by its great utility, if merely taken internally, in very irritable digestive organs.

An hour is the general length of a bath, and the course usually comprises twenty-one. Persons bathe here separately, in single baignoires, or in larger ones in common with several other persons. After the bath, the invalid generally lies down for a quarter of an hour. The water is conducted by pipes into the bath vault, and constantly flows into each baignoire. As soon as a certain height is reached it flows out again. The temperature of the baths in Pfäfers, uncooled, is about 29° Reaumur, $=97\frac{1}{4}°$ Fahrenheit; in Ragaz, 27° to 28° Reaumur, $=92\frac{3}{4}°$ to 95° Fahrenheit.

Every evening the water is let off, and the baignoires are cleaned. Some vapour is perceived in the bath-rooms when cold air enters at the opening of the doors, but this is not so perceptible to the bather himself. Where a greater quantity of water flows into the basin, the vapour appears more concentrated, and is employed as a natural vapour-bath with very favourable results.

The tubes out of which the water is discharged serve as weak douches on different parts of the body. But there are besides douches in separate rooms, fitted at a height of twelve feet, and falling down as rain, stream, or drop douches.

What is called *ausbaden* (out-bathing), formerly much in vogue here, consists in enforcing bath eruption by very prolonged bathing, and is connected with such dangerous processes, as to be now nearly abandoned. The bathing had been gradually extended to eight or nine hours per day, so that the patient had merely to alternate between his bed and the bath. Between the fifth and ninth day, feverish chill appeared as the precursor of the bath eruption, which soon followed (between the twelfth and fourteenth day). Bathing was still continued, and prolonged till disappearance of the eruption commenced, when the time of bathing was gradually diminished to the end of the course. Four weeks was its usual duration. The eruption mostly exhibited the miliary character; sometimes mere swelling of hands and feet took place. The paralysed parts were often first affected by the eruption.

Whilst using the bath the diet should be appropriate to the remedial influence, and the clothing warm. As after-cure, no chalybeate spring nor other tonic treatment ought to be employed, for in the spa the cure is often merely instituted, fresh action may be only awakened, and the salutary crisis may not appear before weeks or months have passed. Beware, then, of disturbing the resumed efforts of nature, unless urged by important morbid phenomena.

Often, however, the so-called 'Trauben-cur' (grape-cure), is allowed to follow the course with great benefit. The cooling and solvent properties of the grape diminish the irritability of the vascular system, promote retarded secretions of the vegetative sphere, increase bilification and portal circulation, and thus counteract hæmorrhoidal tendency, or otherwise congestive influences.

I have here again prepared a rough imitation of the thermal water, and the tests I employ show that, like Wildbad, it deserves, as regards its constituents, the former name of 'chemically indifferent.'

I ought not to omit mentioning that here, as in nearly all

German spas, provision is made to give the foreign and inland poor gratuitous accommodation and treatment, with some necessary regulations and restrictions. In many spas there are even funds to pay the travelling expenses of indigent invalids.

Before concluding, I shall quote a few lines from my journal referring to another subject, not devoid of interest for the medical student:—

'Returning from Pfäfers, down to Ragaz, about half way, a small bridge leads over the Tamina, and then a narrow zigzag footpath winds up to the top of the almost perpendicular mountain on the right of the Tamina. Several times I was obliged to stop for want of breath. Looking down, the tremendous precipice caused a slight sensation of giddiness, and made me pursue more vigorously the steep and rugged path. When at last arrived at the summit, a wide prospect opened before my eyes. The only footpath appearing to the traveller leads to an ancient convent, transformed into *a county asylum for lunatics,* under the able direction of Dr. Ellinger, whose acquaintance I made about ten years ago, when I accompanied poor Mr. U—— from Augsburg to Winnenthal, where Dr. E—— was then the resident medical officer. His method of treating the patients, though I only observed it for a short period, filled me with admiration. It seemed to consist in two principles, viz., causing the patients to work and occupy their time by various contrivances, and *speaking with them as if they were perfectly sane.* This latter point is extremely difficult to perform, though apparently easy. For instance, if a patient wishes or utters anything obscure, he neither contradicts it, nor tacitly agrees to it, nor does what is occasionally done by well-disposed physicians, viz., speaks with them as one does with spoiled children. He enters into conversation with them, and treats the subjects broached as if uttered by sane persons. I saw one instance of a woman, whose cell we entered, and who began to talk herself into fury through non-fulfilment of some wishes. The Doctor did not seek for fictitious excuses, but entered on the subject in the manner mentioned, and I was quite surprised *at the decidedly sedative* and striking influence this manner exercised. She was calmed in a few minutes, which tended to confirm the favourable impression at first produced in my mind by this careful psychological management. Of about 150 patients he had under his care for three years, forty were cured, many without any medicine. All his patients seemed deeply attached to him, and readily obeyed him, without murmur or hesitation. Restraint is very rarely resorted to, and only after the failure of all other means. Dr. E—— seeks one reason why Dr. Conolly can *entirely* dispense with restraint, in the supposition that few patients, in his opinion, come fresh in their first violence to Hanwell, but mostly cases of old standing.* The height of the establishment is 2700 feet; that of Pfäfers, 2100 feet; and of Ragaz, 1600 feet above the level of the sea. All the arrangements of the establishment I found most convenient, and the prospects open to the eye on all sides delightful, with a great variety of walks in different directions.'

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* For the sake of humanity, I earnestly hope that this supposition may prove erroneous.

Lecture VI.

GASTEIN.

Gentlemen,—To proceed to Gastein, the shortest route would be to travel directly east until you approach the Alpine Spa, if it were possible to find a beaten path or road leading through all the inaccessible passes and mountains, which separate the two akratic thermæ. You must, therefore, retrace your steps to the north, and make for the eastern extremity of the Boden-see, viz., Bregenz, after having crossed the Rhine above Vadux, and passed through Feldkirch. The steamboat will carry you promptly to the north-western Bavarian town of Lindau. By this time the railroad must be completed, which will take you in a north-easterly direction through Kempten, Kaufbeuern, and Augsburg, and south-east to Munich, on the Isar. The considerable distance noted on the map shrinks into insignificance as soon as you see these blessed iron links connecting the two spots. I may here state, by the bye, that when you travel in Germany, solely guided by map, you must beware of choosing short routes. Apparent detours, even of a very great extent, often bring you sooner to your destination, if you can use steam for your carriage. For nearly all over Germany, the railroads communicate not only with each other, but with all ordinary land and water conveyances. This circumstance makes a journey through the mingled realms, kingdoms, and dukedoms of Germany, extremely pleasant and expeditious. Wherever you arrive, either commodious hotels tempt you with various luxuries and conveniences, if you desire to halt; or a steam-engine hisses with impatience, and flies to convey you to other regions as soon as you have transferred yourself into the carriage; or an 'eilwagen' stands ready with its prancing horses, promising the greatest 'eile' (haste) as soon as you have occupied your seat, though, as you might imagine, after some miles, the horses' zeal is rather cooled through the ruggedness of the road, or possibly through previous work. Nevertheless, you are infinitely pleased not to have shared the fate of another passenger, who preferred the apparently shorter route, and just arrived at a little village a few minutes after the train or boat had left, by which few minutes, however, he may have lost a hundred miles in his day's progress. We must accustom ourselves to cease reckoning distances by miles, when we can so easily travel during our sleep, and find ourselves so near our destination at waking in the morning.

From Munich, the eilwagen starts every afternoon, through Wasserburg, Stein, and Waging, and arrives at Salzburg on the Salzach* at half-past six the following morning, in time for the Gastein diligence, which receives the passengers half-an-hour later. The distance from Munich to Salzburg is thirty-five leagues. A more interesting and not much longer route is preferred by many tourists—viz., to bend more to the south-east, and pass through Rosenheim, where the celebrated salt-works are to be seen, with an extensive prospect of the environs. Thence you might proceed towards the beautiful village of Prien, and cross the interesting Chiemsee (four leagues long) in a steam-boat. A very picturesque view is offered on the lake, of the romantic ruins of Hohenaschau, of the Kompenberge, and the high Hochgern (rising to 6000 feet). You proceed thence to Traunstein, on the Traun, also provided with salt-works, thence through Teisendorf to Reichenhall, on the

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* The Salzach arises in about 47 lat. and 12 east long. at the east of Innsbruck; it then takes a due easterly direction, as far as Lend, where it is entered by the Ache, which originates in the south, from the towering Ankogel, passing Bad Gastein and Hof Gastein. From Lend the Salzach bends to the north-east, leaving Saint Johann on the right, Werfen on the left, Golling on the right, and Halein on the left shore. It then traverses Salzburg, passes Laufen, then turns slightly to the west, and joins the Inn to the east of Munich, to fall with that river into the Danube at Passau.

Saalach, the centre and connecting point of four large salt-mines. The brine is conducted hence by subterranean pipes to Traunstein in the north, and to Rosenheim in the north-west, whilst the place receives the brine from the southern mines of Berchtesgaden. The salt-works are greatly admired by the visitors.

The *Grabenbach* (ditch-river) is particularly worthy of notice. It is a deep subterranean canal, built of brickwork, and destined to receive such sources of the Soole as contain too small a quantity of salt. The curious are carried in boats as far as the river. Though the Ferdinandsberg of Berchtesgaden lies 160 feet higher than Reichenhall, the salt-works had to be artificially raised by water columns to a height of 179 feet more, in order to fall to Reichenhall; wooden and iron pipes extend to upwards of 100,000 feet between the two 'Salinen.' The brine arises here at a depth of fifty feet, and is pumped up by machinery. One part contains such an abundance of salt, that it is immediately transmitted to the boiling-pans without previous graduation. A most charming road leads from this place through the Ramsau to Berchtesgaden (seven leagues south of Salzburg). You pass between high and interesting mountain walls to the Taubensee, and soon afterwards to the village of Ramsau. The valley now enlarges, and the road passes the 'Illsangmühle,' where Reichenbach's celebrated water-lifting machines are seen, which raise the saturated brine by hydraulic pressure, in pipes 3500 feet long, and 1200 feet high. A league and a half further you reach the charming and picturesque Berchtesgaden, with an antique chateau, annually visited by the King of Bavaria. The salt-works here possess great interest. In the little chateau of Adelsheim, you may inspect the 'Klausnerische' collection of ivory and wood-cut wares of Brechtesgaden. The most magnificent views are furnished by the 'König-see,' (King's Lake,) south of Berchtesgaden. The encircling high cliffs impart to the whole a solemn grandeur. The water is dark green, but appears quite black near the shore, through the overhanging rocks. At the end of the lake a smiling meadow suddenly opens to your view, with a hunting-castle at the foot of the towering Watzmann (9000 feet high). With a powerful telescope you can perceive the chamois leaping among the glaciers. Good pedestrians may easily wander from here to the 'Eiscapelle,' the lowest glacier in existence. The 'Schreinbach,' falling into the 'König-see' at the southern extremity, with its white foam, forms a curious contrast with the dark water of the lake.

During the presence of the Court, grand stag and chamois hunts take place upon the lake, the animals being driven into the water from the neighbouring mountains. A short walk towards the north brings you to Salzburg. I dwell with greater length and emphasis on this journey than on others, because it forcibly struck me as I proceeded, that such varieties of scenery, such contrasts of atmospheric influences, acting on the senses and faculties of the traveller, must exert a positively healing action in many derangements of physical and mental functions. I defy the hypochondriac to think of his manifold and magnified sorrows, when beholding these wonders of creation. Intense cheerfulness fills his mind and dispels every depressing thought. The secreting and excreting organs resume their former healthy activity. The formation of good chyle improves the condition of the blood. The nutrition of the whole frame becomes improved, and reacts tonically on the mind; and thus this cyclus of cause and effect eradicates many an inveterate functional disorder. I do think that travelling certain routes should be advised in many instances, merely for the sake of the journey itself. On this occasion I proceeded from Munich to *Kreuth*, which I may yet visit with you, if time permit, thence to Schwatz on the Inn in Tyrol. From this interesting locality the diligence starts about midnight for Salzburg. The scenery which day-break revealed induced the following remarks in my journal:—'I sat outside in the morning, near the postilion, to inhale God's free air and admire his variegated beautiful landscapes. How I rejoiced at the delightful panorama that opened before me. On both sides of the road beautiful meadows gently rise and abruptly terminate in the mountains, whose rocky summits are sometimes seen rising behind each other, forming extremely romantic and picturesque perspectives. The beautiful town of Salzburg lies in the centre of the so-called ‘ Salzkammer gut’ (salt-chamber-domain) bounded on three sides by mountains, and divided into two parts by the rapid Salzach, which is crossed by a large bridge. The town contains 15,000 inhabitants, and lies in a valley between the Mönchsberg and Capucinerberg, from which you enjoy magnificent views of the environs. The ‘ Festung’ (fortress) of Hohensalzburg lies on a commanding position, overlooking the whole town. If you take a survey of the town from that eminence, it appears more charming than it really is. I next visited ‘ Aigen,’ beautiful and park-like, full of grottoes, waterfalls, rocks and labyrinths. A spot is pointed out here by the guide as the favourite resort of his Majesty King Louis of Bavaria, who is certainly an excellent judge of picturesque scenery, for it becomes difficult to satiate your sight with the alternating heights and valleys, glaciers and castles, that arrest your eyes from different points. Amongst the numerous curiosities of Salzburg, well worthy of inspection, I was particularly struck by the cemetery of St. Petri and its antiquarian monuments, by the interesting gate hewn through the rocks, with the proud inscription : ‘Te Saxa loquentur, &c.’* But however imposing and romantic the views at a distance, the streets are narrow, and the houses apparently damp and close, though the place is alleged to be very healthy. Of the great purity and salubrity of the air in the environs there cannot be the slightest doubt. At seven A.M. I took my place in the diligence, and passed through Hallein, Golling, Werfen, St. Johann, Lend to Hofgastein, (where we arrived at half-past eight P.M.) and Wildbadgastein (at half-past ten P.M.), about thirty-two leagues in fifteen hours and a half. The road, particularly after Golling, is magnificent beyond description. It is more like a fairy-land than a reality, particularly the ‘ Lueger-pass,’ where a small path leads upwards to the 'Ofen der Salzach,' is certainly the most magnificent view that the imagination can conceive. It is the perfection of picturesque scenery. The spot which struck me as most admirable, is where the Salzach-bridge stands surrounded on all sides by the mountains, as if the world were locked off beyond, and all further passage prevented. And if you now think your admiration has reached the highest point, and that greater natural beauty cannot exist, pass on further, and you will find how mistaken you were in this belief. Rocks, mountains, valleys, verdant fields, and deep ravines perpetually diversify the scene, while the Salzach coquettishly winding every now and then across your path, and forcing you to cross and recross her silvery current, contributes to render the whole scene so charming and heart-expanding, that none can forbear blessing his Creator, and pouring out his overflowing gratitude.'

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* The rocks will speak of the (Ovens of the Salzach, so called because the Salzach breaks here through oven-like rocks).

Gastein, lat. 47, long. east 13.—The valley of Gastein is intersected in its whole length (for eleven leagues), by the rapid Ache, which rushes down from the height of 270 feet in the middle of Wildbad, forming one of the most beautiful waterfalls. The spa is supported on the one side by the terrace plain of the Böckstein. On the north a fine prospect opens towards the whole lower valley, whilst on the east and west, mighty columns of primary rocks are perceived, the Tisch, Gamsgarkogl, Thronegg, Graukogl; towards the south, the high plain of Böckstein. The spa lies 3200 feet above the level of the sea, its filial establishment Hofgastein, nearly 2700 feet, thus 500 feet lower. The highest peak of the Gastein mountains reaches an altitude of from 8 to 10,000 feet.

The mean annual temperature is 7° Reaumur; that of the summer, 11° to 12°, being rather lower than in many other spas. Nevertheless, the climate is more bracing than bleak, for the northern storms, as well as the pluvial west and north-west winds, are kept off by the semicircular guard of the surrounding mountains. The easterly winds are partially checked in their violence, by passing over the Arleck and the mountains of the Kotschach valley. Even the

Sirocco from the south, which has such a depressing influence on the nervous system, and mostly appears in Spring and Autumn, is deprived of its violence, by the towering chain, and partly of its heat, by the ice and snow-fields of the environs. West south-west wind is the most frequent. The heat of the summer is rarely oppressive, rapid alpine torrents and neighbouring woods imparting freshness to the atmosphere. The temperature is occasionally exposed to sudden changes in the height of summer. If any tempest discharges itself in the mountains above, rain and cold ensue in the valley as a consequence, with a cloudy appearance of the atmosphere. This becomes sometimes more perceptible through the evaporation of the glaciers, after very great heat, as for instance, when the thermometer has risen to 20° and 24° Reaumur. The spring exhibits fewer changes, and is more adapted for courses of the water than is generally supposed. The natural alpine spring water, colder in summer and warmer in winter than the atmosphere, is considered so advantageous from its excellence and purity, as to be often made use of medicinally in cases of indigestion, and a weak condition of the mucous membrane of the intestinal canal. The air absorbed by the ordinary water contains 30 vols. of oxygen to 70 of nitrogen. The spring water may partly derive its stimulating and decarbonising influence from this increased proportion of oxygen. You are aware, however, that water generally contains a greater quantity of oxygen than of nitrogen, so that you have always to expect an increased proportion of the former even in common water. You will recollect that 100 vols. of water absorb about 6 of oxygen and 4 of nitrogen. The barometric pressure is diminished by more than 3 inches (24″ 5‴). Thus, if the whole weight of the atmosphere borne by one individual is equal to 14 tons = 28,000 pounds, one inch corresponding to 1000 pounds, a diminution of nearly 4000 pounds exists in Gastein. The atmosphere is consequently purer, lighter, and (as it is asserted) more charged with positive electricity in proportion. The influence of light is also supposed to be more enlivening and stimulating by passing through a less resisting and more attenuated aerial medium. It is thus assumed, that in such alpine heights pulmonary circulation, and, in consequence, arterialisation of the blood, are accelerated, and the quantity of venous blood proportionally diminished.

From the above reasons you see the animal and vegetable kingdoms develope greater strength and vitality in these heights than in the lower regions. The beneficial atmospheric influence is particularly felt by persons coming from flat countries, from the shores of the north and Baltic sea, &c. An unusual ease spreads over the whole organism, respiration is more easily performed, the head is raised, the walk is erect, with a certain lightness and elasticity of movement. An instinctive desire for muscular exercise helps to increase the general effect, and induces keener appetite and sounder sleep. The necessity for a certain amount of oxygen must induce deeper inspirations than in low localities, where the compressed air contains a greater quantity in a smaller volume. Patients with weak thoracic organs feel in such heights at first a certain oppression, they have a sensation as if they could not obtain a sufficient quantum of air. This, however, enforces a gradually increased expansion of the chest, and deeper inspirations. On this account tubercular diathesis, for instance, is so greatly counteracted by Kreuth, because the greater dilation of the pulmonary cells mechanically prevents further or incipient deposits in the interstitial tissue.

The venous blood being allowed freer reflux by the promoted circulation, obstruction of the portal system is diminished. The intestinal canal exhibits greater tone. Exhalation proceeds with more activity. General nutrition must therefore improve. On the other hand, in confirmed phthisis, or congestion of the brain, or internal inflammation, alpine air must be injurious. The increased pulmonary action occasions a speedier exhaustion of the lungs, whilst the stimulated vascular arterialisation heightens the inflammatory symptoms.

The spa has been in repute for centuries. Its annals state:—'That more than 400 years ago (1436), the Emperor Frederic the Third used it for an open sore in his thigh, and left it completely cured.' The bath hospital was founded nearly 400 years ago for indigent patients. Paracelsus said of Gastein, more than 300 years ago:—'it opens scars, cures paralysis, dispels contractions and gravel.'

Baths are erected in every house destined for the accommodation of the visitors, with a reservoir of thermal water, possessing the requisite temperature for bathing. The 'Badschloss,' Straubinger, &c., possess large baignoires for persons bathing in greater numbers. The more modern buildings, however, possess merely separate baths, as spaciously and conveniently constructed as possible, so that the patient can move about and be in constant contact with a great amount of thermal water.

Apparatus for douche, shower, and rain baths are attached to all these localities.

Wildbad-gastein offers several shady walks to the visitors. Excursions to the Bellevue, or the 'Russian coffee-house,' furnish fine prospects of the immediate neighbourhood.

Active pedestrians will be well rewarded for walking to the castle of Hunsdorf, with the charming prospect of the Graukogl, Gamsgarkogl, a glacier, lying between the two (the Tischlerkaar) and the Ankogl. Others wander to the neighbouring mines of Böckstein, celebrated for the gold-washing performed there. The 'Schweizerhaus' (Swiss-house), situated between Wildbad and Hofgastein, collects visitors wishing to combine enjoyment of fine scenery with social amusement and rest. In the neighbourhood is also to be found the 'English coffee-house,' with a fine view of the valley, besides 'Badbrück or Patschgerhaus,' with its pretty pond for trout. For further excursions, the Anger Kotschach and Anlauf valley are chosen.

If unfavourable weather prevents out-door exercise, the guests avail themselves of the beautiful 'Wandelbahn' (walking path), upwards of 400 feet long and 20 feet wide, where you can not only walk about at your leisure, but enjoy charming prospects, and contemplation of the various groups formed round tables in different parts of this capacious locality. At certain hours of the day delightful music heightens the pleasure of muscular exercise.

The character of the mountain-masses is primitive. The healing springs originate from gneiss, at the foot of the mighty Graukogl, on both sides the Ache. Towards the elevated southern Böckstein, granite formation appears, whilst towards the northern valley, near Badbrück, mica-slate is found, characterising the Gamsgarkogl and neighbouring mountains. The declivities of the mountain masses, at the east and west of Wildbadgastein, are superposed by strata of primary rocks, while the deeper valley of Hofgastein is partly covered by the rocks of the surrounding mountains, and partly by alluvial conglomerations. These primitive mountains formerly concealed numerous minerals in their womb, particularly gold, which was obtained to a considerable amount; but now the gold-washing is performed less for profit, than to satisfy the curiosity of the visitors.

The order in which the sources arise are, 1, the highest, *Fürstenquelle*, 37° Reaumur = 115¼° Fahrenheit, furnishing 16,000 cubic feet of water in twenty-four hours, and supplying the baths of the Archduke Johann, those of Straubinger, of the Prälatur, Solitude, &c.

2. The *Doctorsquelle*, lower and more northerly, 36° Reaumur = 113° Fahrenheit. About 3000 cubic feet of water are furnished daily, and conducted by forcing pumps into the Badeschloss.

3. The *Schröpfbad*, or Chirurgenquelle,* still more northerly, temperature 36° Reaumur = 113° Fahrenheit. The daily quantity of water is below 4000 cubic feet, and supplies the baths of the surgeon.

4. *Hauptquelle* (*chief source*), the lowest, but, at the same time, the most abundant. A new enclosure of brickwork leads to its issue. The temperature of the bubbling spring is 38½° R., = 118½° Fahrenheit; its daily quantity

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* Cupping-bath, or surgeon's-spring.

100,000 cubic feet. It supplies the baths of the Mitterwirth, Krämer, Bath-hospital, and the filial establishment of Hofgastein. The vapours evolved from the water are conducted into a separate locality, and used as vapour baths.

There is besides on the right bank of the Ache the *Ferdinandsquelle,* with 33° Reaumur; then the *Wasserfallquelle,* with 28° Reaumur; and on the left shore of the Ache, the *Grabenbäckerquelle,* with 29° Reaumur. The water is clear, inodorous, and tasteless. Specific grav. 10004. It is composed of—

1.51 sulph. of soda ($1\frac{1}{2}$ gr.)
0.36 chlor. of sodium (about one-third).
0.36 carbonate of lime (about one-third).
0.05 carbonate of iron (one-twentieth gr.)
0.24 silex (about one-fourth gr.)

with a small quantity of sulphate of potash, carbonate of soda, of magnesia, and *glairine,* amounting together to 2.73 grains in 16 ounces. 100 parts of the gas contained in the water, consist of 3.8 carbonic acid, 29.0 oxygen, and 65.1 nitrogen; 100 parts of water contain 0.18 of carbonic acid, 0.90 of oxygen, and 2.02 of nitrogen. Its power of conducting electricity was compared with that of distilled water, and led to the following results:—

1. Distilled water of the temperature of 14.1° Reaumur, caused the needle of the galvanometer to diverge to $3\frac{1}{2}$°.

2. Gastein water, kept nineteen days, in an open bottle, with a temperature of 14.4° Reaumur, induced a divergence of 29°.

3. Fresh spa water of 24.4° Reaumur, made the needle diverge to 36°, whilst

4. Distilled water, warmed to the same heat, caused a divergence of 6° only.

5. The above-mentioned Gastein water, which had been cooled to 14.4°, being heated likewise to 24·4° Reaumur; the divergence of the needle was 36°.

From the above and many other experiments, it is inferred that the water possesses a greater degree of electro-motor power than well, or distilled water, as a combined result of its alkaline constituents and thermal temperature.

It is thought that owing to the spa water being heated in an enclosed space, beyond atmospheric influence, and without formation of vapour, the warmth penetrates all the particles more uniformly, touching each separately as it were. In water, however, heated by artificial fire, and exposed to atmospheric influence, the warmth is spread by the circulation of the watery particles themselves, so that the calefacient power does not so uniformly act on each atom.

The fact of oxygen possessing magnetic power, lately established by Faraday, may also assist in explaining the great importance of a high position. The same savant has proved, that not only heat, but carbonic acid, and other gases, diminish or destroy this magnetic power. Thus we may consider, that in low situations, the protective magnetic force of oxygen is counteracted, both by the warmth of the circumambient animal exhalations, and by the exhaled gaseous bodies. The diminished magnetic tension may then give greater scope and freedom to the development of miasmatic impurities in the atmosphere, which react again in their turn, on the living beings from whom they had originally emanated.

Though the temperature of the chief source is only 38½° Reaumur, a sufficiency of vapour is evolved for use. From each layer, as it rises, issues a quantity of steam, whilst in boiling water only the superficial layer developes steam, and must constantly be supplanted by a deeper layer rising from the bottom.

A whitish-grey gelatinous substance, gradually assuming a denser tissue, is observed at the bottom and sides of the effluxes, forming the Gastein bath-mud (*ulva thermalis*).

To the supposition that climatic influences alone produce the observed changes, it is objected, that the inhabitants of Gastein are often affected with the fever of reaction, when using the baths, whilst this is never observed when bathing in the well-water of St. Wolfgang, warmed to 28° Reaumur, in the neighbouring Fusch-valley, which lies 800 feet higher than Gastein. The above analysis shows sulphate of soda to be the chief constituent, with a small quantity of chloride of sodium, and carbonate of lime. You have to bear in mind, that the constant renewal of the water together with the great quantity provided for each bath, may cause a proportionally greater absorption of the ingredients.

The baignoires are from four to five feet deep, and hold from 150 to upwards of 300 cubic feet of water, (that is from 8,500 to 17,000 pounds). They consequently contain from three to six pounds of sulphate of soda and other mineral substances. These constituents being presented to the absorbent vessels in such a highly diluted condition, are fit to become absorbed and assimilated.

The bathing basins are constructed of wood, and communicate both with the reservoirs and springs, so as to admit of a constant renewal.

A feeling of general ease pervades the bather; greater elasticity of body and mind is experienced; the circulation becomes more active, the pulse somewhat fuller, and occasionally more frequent. If the stay is prolonged to an hour, relaxation ensues, sometimes a slight chilliness, inclination to sleep, and other signs indicating the necessity of leaving the bath. A short repose on the bed after leaving the bath, brings out a pricking sensation of the skin, particularly in such parts as have been subjected to gentle rubbing. Perspiration is rare.

Healthy persons, after bathing for several days, feel stimulation of the vascular and nervous systems, increased frequency and strength of the pulse, sometimes even giddiness, aridity of the skin, restlessness, and diminished appetite. To plethoric persons in general, Gastein is less adapted than to weakened and anæmic individuals.

Derangements based on vital inactivity and torpor, or on disturbed dynamical functions of the cerebral and spinal nervous system, will find a fitting remedy in Gastein. After the first seven or ten baths the appetite improves, sleep becomes sounder, pulse and complexion more lively, and the general functions of the muscular and sero-fibrous organs increased. If still continued, reaction sometimes appears with the usual characteristics, as relaxation, lassitude, headache, mental depression, anorexia, obstruction, &c. Sometimes these phenomena augment to febrile orgasm, when the course should be discontinued for a short time, till the erethism has passed off with salutary crises. This reaction varies in its time of appearance, between the ninth and twenty-first bath. Old rheumatic and arthritic pains often reappear during the course, dormant neuralgiæ are roused, and old scars and paralysed parts become painful.

The solvent power of the spa in inveterate swellings and indurations, is *subordinate* to its dynamical and alterative effect on nervous vitality.

The cutaneous system, having become more susceptible by the alpine character of the situation, is particularly prone to critical results. Glutinous perspiration sometimes covers the affected parts.

After a certain duration of the course, the back, abdomen, and extremities are occasionally affected with a bath eruption, of either a papular or vesicular character. The bath is to be continued till the eruption disappears, unless accompanied by fever or erysipelas, when discontinuance of the course is necessary.

Renal crises are the most frequent; the urine first becomes watery and more abundant, afterwards sedimentous, and particularly charged with deposits in rheumatic and arthritic diseases, and in lithiasis.

Critical stools after reaction are more rare. The regular flow of hæmorrhoids sometimes follows the course, and removes internal diseases which had been produced by its suppression.

Satiety is generally evinced after the twenty-first bath, and requires cessation of the course. In some instances, however, it is put off for a longer period; particularly with very torpid persons the desire for bathing sometimes continues longer. Generally, however, after this period the baths are taken with reluctance and discomfort; the mind becomes peevish and excited, short walks are fatiguing, sleep becomes disturbed, appetite diminished, tongue furred, &c. These symptoms suggest discontinuance of the course, for if prolonged, signs of overbathing will be superadded, viz., palpitation of the heart, oppression of the chest, giddiness, restlessness, chilliness, and at last real fever, which greatly differs in character and intensity from the curative fever of reaction, and requires immediate suspension of the baths, besides careful medical treatment.

Frequently the curative effects of the spa are only exhibited some months after the patient has left the Alps, and returned to his occupation. If no decided indication exists, it would be advisable to leave nature free scope for developing its commenced alteration. The course sometimes merely incites the vis medicatrix naturæ, which then gradually progresses till the morbific cause is expelled.

Gastein is recommended according to Dr. Kiene—

In chronic rheumatism, arising through gradual suppression of insensible perspiration, and often inducing metastases to internal organs; in contractions and stiffness of the joints, if based on rheumatic causes; in rheumatism ensuing after the administration of large doses of bark, particularly when these have quickly suppressed periodical half-sided head or face ache. In morbidly increased sensibility, the lukewarm baths are used; in great torpor, the warmer ones. The perspirations induced after a certain number of baths display acid smell and reaction. Repelled particles are mobilised, diluted, and dissolved, by the stimulus of the congenial fluid. Urinary secretion shows in its sediment, after some time, increased urate of ammonia. In articular rheumatism, the pains sometimes become extremely violent through using the baths, but only to be followed by soothing effects.

In *gout* and *gravel*, more particularly with anæmic and decrepit persons, or such as have been exposed to harassing mental work, without sufficiently strengthening diet. Those persons will be less benefited who possess a plethoric disposition, or who live luxuriously whilst leading a sedentary life, or where there is a natural tendency to expel the morbid matter through the abdominal organs, and where material engorgements are present. Here the cooling and solvent springs of Marienbad, Franzensbad, and Kissingen, will be indicated in some instances, in others, the penetrating thermæ of Karlsbaden, or Wiesbaden. Gastein is in such cases often resorted to with great advantage as an after cure, to raise the nervous power, after the exhausting material eliminations.

Regular local paroxysms of gout are not cured in Gastein, but their frequency and violence are diminished, by partly preventing new deposits of arthritic concretions. Gout in the articular apparatus of the vertebral column, characterised by dull dorsal pains, and increased by motion, is particularly amenable to the baths and vapour-douche of Gastein. *In arthritic ankylosis,* when the synovial membranes are filled with uric or calcareous sediments,from deficient organic power of transforming these substances, when the skin and kidneys have diminished their secreting activity, the internal and external use of Gastein is very useful. Diarrhœa, through arthritic dyscrasia, also gonorrhœa from the same cause, are relieved here.

Gastein is reputed for expelling sand and gravel. When repelled podagra has produced the evil, the disease becomes localised again through the baths. Nervous gout, ischias nervosa, gonorrhœal gout, prosopalgia of rheumatic or arthritic origin, also if purely nervous without organic change, neuralgia brachialis, plantaris, &c., are all enumerated amongst the category of diseases curable by Gastein.

*Writer's cramp** is very often cured here. Habitual spasms of the stomach and colic are only relieved in persons of great nervous weakness. In debility of the abdominal nervous plexus after cholera, in trembling of the limbs produced by general cessation of strength in old age, &c., the power of the spa is extolled. *Somnambulismus,* based on predominant nervous irritability of the uterine plexus, with prostration of the central nervous system, is often relieved here. A case is recorded by Dr. Kiene of a young lady of seventeen years of age, who was completely cured by a course of twenty-one baths. The first day the temperature was 23° Reaumur, and the stay in the bath five minutes; the next day, temperature 24° Reaumur, and stay ten minutes; the following day 25° Reaumur, and a quarter of an hour's stay, and all the following 25° Reaumur, of half an hour's duration. On the fifth day the paroxysms reappeared, but weaker; again, on the ninth, with still less violence, and subsequently none.

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* I have myself travelled with a gentleman who was completely freed from this evil at Gastein.

As regards *diseases of the spinal marrow,* Gastein is not indicated, when inflammation, suppuration, or fever is present; but where exhaustion of nervous power exists, through excessive losses or weakening diseases, Gastein is eminently curative. Spinal irritation and hyperæsthesis, paralysis of the lower extremities, pure nervous weakness, marasmus senilis, spermatic weakness, morbid atonic perspirations, *coxarthrocace* (luxatio spontanea), are all asserted to find frequent cures at the spa.

The above array of maladies might easily provoke a smile of incredulity. 'What!' you will say, 'does Gastein exhaust all these classes of pathology? how can the same remedy cure diseases so diversified in their nature, appearance, and character? If it be decidedly able to heal the one, it must prove inert, or even injurious in the other.'

You have to bear in mind, that a spa of such mysterious properties serves as a last resort in many cases where the ordinary remedial store has been exhausted in vain. Persons suffering with the varied derangements enumerated, have, no doubt, found relief there. The scientific standing of Dr. Kiene, who enjoys a high repute in Germany, and who practised at the place for nineteen years, sufficiently guarantees the truthfulness of his accounts.

But the question between certain diseases cured there, and what patients you should rather send to Gastein than to other spas, is widely different. Many a sufferer is relieved from disease under a course of certain pharmaceutic remedies, and yet we may hesitate to ascribe the cure to their agency. I might just mention an instance: an out-patient of the German Hospital, the wife of a policeman, was affected with impetigo on both cheeks, on the forehead, and on the nipples of the two breasts. In all other respects she was perfectly healthy. Age between nineteen and twenty—in the fifth month of pregnancy. Not the remotest sign of dyscrasia was present. The impression was altogether that of a well-proportioned healthy person, with very dark hair. There being no decisive indication, I gave her a solution of sulphate of soda with a view to keep up a gently increased action of the liver and portal system. Improvement taking place after a few weeks, I saw no reason for changing the treatment. She took nothing else in the shape of either internal or external medicine for three months, and now she is completely cured. Still I would not venture to state or to think, that sulphate of soda cured her, though a very obstinate case of ecthyma faciei of an in-patient who had in vain taken liq. arsenic. and Donovan's solution, was cured under the influence of the same remedy.

May not a similar result happen in various spas? Many a cure may take place through secondary circumstances, and, as I mentioned formerly, I have made it my chief task to point out those ailments in which such or such springs are primarily indicated.

The *ensemble* of Gastein adapts it to those chronic diseases in which the nervous system has been peculiarly weakened or altered in its function. We have to consider the three media, from which curative influences may ensue. The inherent caloric, the constituents, and the bracing alpine air with its diminished atmospheric pressure.

I need not tell you what a great number of nervous affections are daily produced by repelled gout, or by retrocession of piles, or of cutaneous eruptions. The general increase of peripheric functions, inducing a derivation from the internal organs, may act healingly in one instance. The roused torpidity of the nervous centres is able, in another instance, to call dormant organs into fresh action, and to elicit imbedded particles from their obnoxious position.

In a third instance, the great quantity of the highly-diluted warm fluid, with its sulphate of soda, chloride of sodium, carbonate of lime, and of iron, may enter into combination with the circulating organic liquids, and partially dissolve stagnant substances, and fit them for elimination. The decided utility of Gastein in gravel would lead to this supposition, for its composition bears some analogy to Karlsbad, where also sulphate of soda forms the chief constituent, and where chloride of sodium and carbonate of lime are in subordinate quantities with carbonate of soda.

In conclusion, Gentlemen, I shall quote a few lines from my journal:—

'Aug. 17th.—I was much disturbed the whole of last night by the roaring waterfall of the Ache. Dr. Kiene, whom I saw in the morning, considers Gastein particularly efficacious in torpor of the nervous system, paralysis, *erratic gout, premature age;* in fact, whenever spasms or paralytic affections are produced by deficient nervous power, Gastein cures by raising this power.

'I walked from Wildbad-gastein down to Hof-gastein (about one hour and three quarters); although it rained, the walk was extremely picturesque and romantic.

'The water of the chief spring is about thirty-nine degrees of Reaumur in Gastein; it is allowed to cool over night, or cooled and thermal water are let from two pipes into the bath, which thereby acquires the desired temperature. From this chief source the water is conducted in wooden pipes down to Hofgastein, where it arrives, according to atmospheric temperature, with a warmth of about 30° Reaumur. Then it runs constantly out of pipes into the baths, which cool down to 28° or 27° Reaumur by standing a few hours.

'Dr. Sleting (practising at Hof-gastein) considers it advantageous in the filial establishment that the water does not require cooling, that the climate of Hof-gastein is milder and dryer than the parent spa, enjoying the sun three hours longer every day (which must be considered very beneficial in nervous diseases). The walks are more level than the mountainous regions of Wildbad-gastein. It is more accessible, but less comfortably constructed; in fact, the locality seems rather neglected, and actually looked down upon by its elevated parent. Dr. Sleting related to me several cases of cramps of the stomach, which found a permanent cure at his spa. Also some cases of sterility, and of paralysis through spinal concussions and wounds, that had been cured at Hof-gastein. Sal. H——, of Danzig, who suffered from a kind of chorea (viz., fits of bellowing and imitating various animals) was completely restored here. Schönlein sent to him a remarkable case of an affection of the *nervous vagus*—viz., by seeing others eat, the patient got violent pains in the epigastrium, which spread to the throat, and impeded deglutition. This was also relieved. Varicose ulcers are likewise often cured there.—The pores become contracted in the bath, the skin paler. Perspiration never ensues, whilst diuresis is invariably increased, and Dr. Sleting laid particular stress on the *sound critical sleep* that is enjoyed by nervous patients. He also mentioned a case of diabetes mellitus, where perspiration regularly ensued at night, the quantity of urine diminished two-thirds, strength increased, and the patient left greatly relieved though not cured. As regards lithiasis, particularly in the phosphatic diathesis, it frequently finds relief in Gastein.

'I spoke with a commandant in the free military bathing establishment, who was cured of pain and stiffness in the right femur, where he had been wounded by a ball. I saw many persons who had been cured from traumatic stiffness and spasmodic contractions.

'How, then, is the indication to be fixed, and the choice to be made between the three akratic spas visited?

'*Wildbad* is more indicated in *nodous gout*, and in those cases of paralysis and contraction where absorption is to be promoted, and where resolution of effete concretions and deposits are the chief task of the healing process.

'*Pfäfers* is rather useful in *atonic, metastatic gout*, in hemiplegia after apoplexy, and in paralysis connected with the absence of *true* nervous sensibility, also when the disease is more the immediate effect of the concussion or lesion of muscular tendons or nervous centres.

'*Gastein*, however, is more indicated in irregular and depraved nervous action, based on atony. Therefore, it is eminently useful in writer's cramp, spasms of internal organs, affections of the nervus vagus, trigeminus, &c., paralysis with general torpor, and *deficient calefaction.* The water increases the tone of the nervous system, and regulates its power. Persons with seminal weakness, whose irritability had been increased by sea-baths, were cured here, by the increased erectile power, and testicular contraction following the use of the baths, with restoration of the exhausted nervous vitality.'

I trust, then, Gentlemen, that in the generality of cases, by taking all the above points into consideration, you will have no difficulty in deciding to which of the three springs to recommend your patient.

LECTURE VII.

ISCHL—TEPLITZ.

GENTLEMEN,—Having remained a sufficient time in Gastein, you will leave at five in the morning by the diligence, to return to Salzburg. On arriving at Hallein, the last stage before reaching Salzburg (at about half-past five P.M.), I would advise you to stop and inspect the interesting salt-works. I find in my journal the following note:—'We had to ascend a high mountain, when the guide, for the purpose of shortening our route, led us along a footpath across narrow planks over precipices frightful to contemplate, from the unsafe footing, at several spots. The guide walks before with a steady step (for the planks will not admit of two persons abreast), and though he assured me, that ladies even frequently chose this dangerous bridge of planks, I apprehended that they must have been deceived by the guide, who merely asks, whether a shorter way would be preferred, without informing the unwary passenger of the imminent peril he has to encounter, for the mere purpose of saving a few minutes. The guide advises you to hold fast by him, and to look upwards, in order to prevent giddiness, for one false step might hurl you down a fearful abyss. I confess that I was very indignant at the deception practised on me; but after about ten minutes, the depths below me gradually decreased, and I thanked Providence for a safe arrival at the salt-works. A miner's white dress was put by some official over my clothes, and I was then conducted down the shafts. These are passages hewn out of the salt rocks, and supported by wood; moist and damp at the entrance, but becoming dry as you descend deeper. Though they are extremely long, the air is excellent, and not the slightest oppression or inconvenience in breathing is felt, all the main shafts being so constructed as to admit the fresh air freely. After having to slide down five times into apparent abysses (without any danger, however,) we arrive at last at the principal excavation, with a pool of salt water in the centre, forty feet long, thirty wide, and seven feet deep, illuminated by numerous lamps, which beautifully reflected their rays in the still water, and formed certainly a very agreeable contrast with the darkness out of which we had just emerged. The guide stamped on the ground, and a boat approached from the centre of this subterranean vault. We stepped in, and were drawn to the other side very agreeably. It was explained to us, that sweet water is conducted into the reservoir, up to the ceiling, where it soon saturates itself with salt (absorbing 26¼ per cent.), and precipitates argilla. The ceiling becomes gradually excavated, and the water collects in the pool, which is exhibited to the curious in summer, but boiled in winter for the formation of salt. I was shown very curious kinds of salt rocks, found in the 'saline' at different periods, and some other antiquarian curiosities. We returned to the upper world by a long passage, the walls of which consisted not of salt rocks, but of lime-stone; they were damp, and of an acrid smell.

'We had to sit across a bench, and were then drawn out at a very rapid pace by a man in front. The passage was so narrow as to leave no spare room. The galloping and clattering made me sometimes fancy, in the half darkness, that a horse was dragging me along at this furious pace, till I recollected the narrowness of the passage, which did not allow the slightest alteration of position without the greatest danger of being crushed. Although what I saw was very interesting, still I did not feel altogether satisfied, from not having witnessed the preparation of salt in its various stages.'

After about an hour and a half's ride you arrive at Salzburg. Thence the diligence unfortunately leaves at seven P.M. for Ischl, so that you are deprived of the opportunity of admiring the scenery. You pass through

Hof and the pleasant village of St. Gilgen, lying on the Aber-or Wolfgang-Lake. Having driven for some time along its banks, you arrive at *Ischl* about three in the morning, with the chance of not finding accommodation till the inhabitants have shaken off their slumber, all the hotels being over-filled with visitors, particularly if the Court happens to be staying there. The ups-and-downs you have had to experience in the 'eilwagen,' sufficiently indicate the mountainous character of the road. Ischl lies in a romantic valley at the foot of the Noric Alps. You see in the immediate neighbourhood the Hallstädter Lake in the south, the Kammer Lake in the north, and the Mond Lake in the west. To the right of Ischl you see the river *Traun* pursuing its northerly direction, to be filtered through the Traun Lake in the north-east. Ischl forms just the centre of the Salzkammergut, and, though upwards of 1400 feet high, its climate is very mild, from the protection against north winds and violent changes afforded by the surrounding mountains. Comparison with the temperature of Vienna* showed the difference to be only one degree of Reaumur. The romantic valley is intersected by the rivers Traun and Ischl. From Schmalnauer's garden, situated on an eminence on the other side of the Ischl river, you enjoy a beautiful view of the surrounding mountain-peaks, with the snow-covered towering Dachstein in the back-ground. The Calvarien mountain is another promenade, which will reward you for your ascent by the views from the portico of the chapel at its summit. It is altogether a very charming place, with about 2000 inhabitants, almost as much frequented for pleasure and recreation as by invalids for the restoration of health. The salt mountain, from which the brine is obtained, lies at some distance, nearly 3000 feet above the level of the sea. The drinking-water is obtained from mountain-springs, arising under lime-stone, and conducted in pipes to Ischl: it is very pure water, notwithstanding the superabundance of salt which exists in the locality. The chief virtue of the spa consists in the brine-baths, taken in the new 'badhaus' in single baignoires, where portions of brine, added to warm baths of ordinary water, are frequently prescribed. Here, again, you see all possible contrivances to meet the various contingencies of different maladies. Ischl has only been in repute about thirty years, as a mineral watering-place, and I might also say was created a spa by the self-sacrifice, exertion, and munificence of the late Dr. Wirer, who spent a large fortune in accomplishing the beautiful arrangements, all tending to one purpose. The brine derived from the salt-works contains in sixteen ounces—

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* Which lies about 900 feet lower.

223 grains of chloride of sodium,
0·78 of chloride of calcium,
7·10 of chloride of magnesium,
4·85 of sulphate of soda,
1·02 of sulphate of lime,
1·82 sulphate of magnesia.

Total, 238·591 grains.

A cold sulphur spring, with a strong smell of sulphuretted hydrogen, but with an undetermined quantity of the gas, is found at the place, but is little used by itself. It possesses sixty grains of solid constituents in sixteen ounces, viz., 44¼ chloride of sodium, 12⅓ sulphate of soda, 1½ sulphate of magnesia, 1 and 1-10th sulphate of lime, nearly one grain of carbonate of magnesia, and about 1-5th of carbonate of lime. Into how many remedies did the energy and perseverance of one mind transform the meagre enumeration of elements for combating chronic diseases, possessed by Ischl thirty years ago! Now you have, beside the salt baths referred to, douche, rain, and vapour baths.

The boiling salt-water is used medicinally as a saline vapour bath. Then you find black moor baths (containing, among other ingredients, phosphate of iron); then, again, there are the saline mud-baths. These two are either used separately or mixed. There is also a swimming-school erected for sanitary purposes. Herbs gathered on the mountain are employed in the preparation of a sort of whey, very agreeable to the taste. On the promenade, the visitors will be observed to stop, from time to time, at a certain stall, and quaff their morning beverages; and you will perceive the greatest number of drinkers receive the recently prepared whey, brought fresh from the Calvarien mountain. But you will find a goodly number of other bottles standing ready for the numerous patients. These are imported mineral waters. Thus, while one patient uses brine baths, with whey, for obstruction of the lymphatic glands, another takes mud baths, and drinks Carlsbad sprudel or Marienbad kreuzbrunnen, for some gouty affection of the lower extremities, or engorgement of the liver. Ischl is very much resorted to by the fair sex, and has a great reputation in swelling and incipient induration of the ovaries, if not of a malignant character; also in slighter degrees of hepatic enlargements, sluggishness of the liver, with habitual constipation, and scrofulous diathesis; luxatio spontanea of children is especially expatiated upon as a disease most frequently removed here. Poultices of mountain mud* are often employed in caries, and, it is alleged, with great advantage. The peat ground is found at the distance of about half a league from Ischl, and baths are either taken there or the moor is carried to the bath-house, and administered in contractions from wounds or chronic gout, alone or mixed with mud, or with mother-lye of the 'soole,' or with the water of the sulphur-spring. There is also an establishment for gymnastic exercises. The mountain strawberries are occasionally ordered to be taken at regular intervals for medicinal purposes. The variety of adjuvants called into requisition at this spa will probably induce you to question the efficacy and remedial powers of the water; but if we consider the various morbid dispositions resorting to the spa, we need not wonder that the other advantages which it possesses should be made use of for augmenting the vital powers and counteracting morbific tendencies. The acknowledged efficacy of saline baths in certain diseases of the lymphatic and sero-fibrous system, and in obstructed circulation, would indicate that in all such cases these baths might be appropriately resorted to. The late Professor *d'Outrepont* of Würzburg, mentions the following case of a lady, whom he sent to Ischl. About the period of puberty she was bitten on the left breast. Some hæmorrhage ensued, with inflammation, but as, from a feeling of timidity, she neglected to disclose the accident, induration ensued. She married after some years, and enjoyed perfect health with the above exception. No offspring resulting from the union, the sterility was thought by the husband to be connected with the mammary disease, and therefore many remedies and baths were employed for its cure. Extirpation was recommended amongst others; but was not consented to by the patient, because she had suffered no pain from the enlargement. Sixteen years after her marriage, Professor d'Outrepont was consulted. He found the left mamma considerably enlarged, the skin very white, and the induration consisting of five different moveable tumours. These tumours had given her no pain for many years, nor had they increased in size. There was no trace of scrofula; all the glands were in a perfectly healthy condition, and none of the family had ever suffered with a similar disease; so that the mechanical lesion could alone be the cause of the evil. Iodine having been already administered internally and externally to no purpose, the Professor recommended her to go to Ischl. After three months she returned cured, the tumours had entirely disappeared, whilst the healthy breast had not diminished in size. He would not decide whether the cure was due to the poultices of mountain mud and peat rubbed into a fine dough with mother-lye, or to the brine baths employed. Another analogous case is related by the same authority, of a young man who injured one testicle with a hook on putting on his boots. The testicle swelled to the size of a goose egg. After numerous remedies extirpation was advised, but the patient would not consent, as he had suffered no pain. The generative functions were not impeded, the patient having become the father of several children. Fifteen years afterwards, the Professor saw him and found the testicle quite hard, but not painful; spermatic cord and epididymis perfectly healthy; the scrotum tense, thin, and reddish. The right testicle was healthy. Neither the inguinal nor submaxillary glands were affected. He had never suffered from scrofula, and was quite healthy in every other respect. This patient was also sent to Ischl, and returned cured after ten weeks; but the affected testicle had become atrophied. The physicians of the spa are Dr. Brenner, knight of Felsach, and director of the bath establishment, and Dr. Pollack, both of whom have written on the virtues of Ischl, works well worthy of being consulted. That of the latter physician is published in the more universal language—the French. But let us proceed in our journey. A kind of omnibus leaves at ten in the morning, and takes you in two hours to Ebnsee. Here a steam-boat is in readiness to take the passengers over the Gemünder or Traun lake. In fine weather you will be pleased with the prospects from the water. The passage lasts about an hour. At the mouth of the Traun you perceive the village of Langbath; farther on, and on the right side of the lake, arise the perpendicular walls of the Traunstein (3000 feet high); while on your left lies the village of Traunkirchen, built on a sort of isthmus in the lake. Lastly, you pass the chateau of Orth, situated on a small island, and ultimately land at the little town of Gmünden.

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* That portion of humus which precipitates in the salt mountain during the formation of the salt, chiefly consisting of argilla, sulphate of lime, sulphate of soda, &c.

Here, after taking refreshment, you avail yourself of a horse-railroad. Starting at a quarter past three, you arrive at Linz (nine German miles—about forty-five English,) in six hours.

From this town, which is situated on the right bank of the Danube, you travel by steam-boat to Vienna. Starting at seven in the morning, you arrive at Vienna at four P.M., a distance of about thirty-six leagues. If you wish to pursue your northward course, and leave the visit to Baden for a future opportunity, the railroad affords you this facility, for it starts at half-past seven in the evening, and brings you to Prague, on the Moldau,* in sixteen hours. After some little delay, the railroad carries you nearer still to your destination, viz., to Lobositz. This place is situated on the Elbe,† and the journey of about forty-five miles is travelled in three hours. The best Bohemian wine is grown in this neighbourhood. We are now within about fifteen miles of Teplitz. A sort of omnibus is in waiting for the railroad travellers alighting here; but I would advise you rather to avail yourselves of the diligence, as the omnibus is very slow. The 'Paschkopole' is pointed out to you, a pass between the Mileschauer and Kletschen mountains, formerly notorious for the many highway robberies committed. The approach to the spa is very striking. After having driven for some time through ordinary fields and plains, your attention is suddenly arrested by the gentle undulations of the scene. The view of distant mountains, covered with a lively green, promises to afford you purer air and a more cheerful locality. You are not deceived. The scenery augments in variety and interest, and every object silently informs you, that, from the comparatively barren and unfavoured regions, you are arriving at one of nature's favourite localities.

At about half-past seven you enter *Teplitz*, having completed the immense distance from Vienna in exactly twenty-four hours. It is situated about 51° latitude, and 14° eastern longitude, in the Leitmeritzer Kreis (circle) at the north-western extremity of the middle mountains, and at the south of the Erz mountains, in a fertile and charming valley. You see on the local map the mountainous semicircle at the north-west and south-east. Its elevation over the north-sea is 648 feet. Aussig on the Elbe lies only ten miles to the east, Brux at an equal distance to the south-west. Nearer you see Bilin in the south, nearer still Dux. Somewhat more southerly, you perceive at the western extremity, below Brux, Püllna, so well known for its bitter water. If a line be drawn to the east, you meet with Seidlitz, the salts of which are supposed to be imitated under the form of Seidlitz powders; and farther east Seidschütz, which holds an intermediate rank between the said two bitter waters, as regards medicinal power. Dresden on the Elbe lies about forty miles to the north, Prague about sixty to the south. The village of Schönau, to the north of Teplitz, may be considered as a suburb. The valley extends downwards as far as Aussig, and upwards to Kaaden, a distance of thirty miles, the width being sometimes contracted by the Erz mountains to two miles and a half. On all sides you find the town surrounded by hills, the Schlossberg on the east, Wachholderberg on the west. Lower are the Spitalberg on the south (between the two former), Kopfhügel and Kreuselsberg to the west, the Judenberg and Schönauerberg to the north-east. The three former are considerably steeper than the latter, which becomes flattened towards the Erzgebirge. The extensive princely garden begins at the foot of the Wachholderberg, and contains a beautiful chateau. The suburb lies rather lower, at the foot of the Spitalberg. The town counts 3000 inhabitants. There are some very good private houses between the city and the suburb. Schönau is intersected by the Saubach, with the declivity of the Schlossberg as its eastern boundary, enclosed on the south by the 'Spitzige' (pointed) and Judenberg, and in the north by the Granzer and Dorner heights, and the Hühnerhügel. The climate of Teplitz is very mild, and the vegetation luxurious in the immediate neighbourhood. Besides the numerous houses and mansions for the wealthy invalid, you find no less than eight establishments for the accommodation of military or indigent patients:—

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* The Moldau arises in the north of the Bohemian mountains, runs first eastward, and then bends to the north to join the Elbe, some distance above Prague.

† The Elbe arises in the Riesengerbirge, below the Schneekoppe, and takes first a southern, then a western, and afterwards a northern course. If you follow its left bank, you will discover where it is entered by the Moldau, higher up by the Eger, then by the Mulde, and further still by the Saale; next by the Havel, which joins it on the right bank. From here it bends to the north-west, and does not deviate from this direction till it has poured its water into the North Sea. The two important towns of Dresden and Hamburg are situated on its banks.

1. The Herrschaftliche Hospital.

2. The Town or Citizens' Hospital, both likewise serve as alms-houses.

3. Dr. John's Hospital, for indigent foreign invalids, receiving poor patients, without distinction of country or creed.

4. The Austrian Military Hospital, with extra rooms for diseased officers.

5. The Saxon Military Bath Establishment.

6. The Prussian Military Bath Institution.

7. The Jews' Hospital.

8. The Saxon foundation of the 26th of July, 1811, founded on the anniversary of a princess then in Carlsbad.

The purpose of the latter consists in not only providing Saxon poor requiring the baths with all necessary accommodation during the course, but also in paying the travelling expenses to and fro. Patients wishing to avail themselves of this charity must apply to the commission before March.

The views from the heights round Teplitz are really charming. The eye ranges with pleasure over the cheerful vallies, studded with villages and rural habitations, whilst it enjoys the contrast formed by the sombre forests, antique castles, and citadels of the Erz mountains. In the princely garden you will be particularly struck by two ponds, with canoes for water exercise; by the beautiful umbrageous walks; and by the park-like farm, from the highest point of which you can obtain a view of the distant Mariaschein, Graupen, and Geyersberg. About half a league from the town you may ascend the Schlossberg. Several gentle hills of basalt and porphyry unite into an extensive plain, and then abruptly rise as a steep cone, covered with wood at its northern and eastern side, whilst the southern wall is bald and rugged. The flattened summit bears the ruins of an old chateau, with antiquarian relics. The distant Elbe becomes here visible to you, also the battle field of Kulm, and a great number of mountains as well as works of human industry and skill. Besides, numerous other places invite your visits, such as the shooting house on the Spitalberg, with its view of the Erz mountains, the woody Lippnay, the charming 'Bergschenke' (mountain inn), with its extensive view, the grotesque Schlakenburg, the Mont Ligne, with its view of Schönau, the Judenberg, with its distant panorama, the village of Dorn, with its garden, hills of porphyry, and murmuring mountain-river, Probstan, with its garden of pheasants, or the more distant Mariaschein (about two leagues), with its thousands of pilgrims at certain festivals, and the mountainous town of Graupen. When you enter this little town, you will be particularly struck by the strong contrast between the wild mountain scenery of the place itself and the garden-like plain in the distance. Somewhat more to the north (three leagues from Teplitz) you can visit the village of Kulm, with its memorable battle-field, and its memorials of the victory of 1813. In the west you may inspect the monastery of Ossegg (two leagues distant), with its extensive orchards. On a high rock in the neighbourhood are to be seen the ruins of Riesenburg. The little town of Dux, with its castle, and the basin cast out of captured Swedish cannons, is also worthy of a visit. In the village of Seberschen, a cold sulphur spring exists. Two leagues to the west of Dux, on the road to Carlsbad, the little town of Brux is often visited. To the east you may visit Aussig, on the left shore of the Elbe (four leagues distant). To the south the Mileschauer, the highest peak of the middle mountains, 2,700 feet high (four leagues from Teplitz); most extensive prospects are offered on its summit. In the east the eye reaches the Riesengebirge, the towns of Leitmeritz and Theresienstadt; on the Elbe to the south you perceive the Euler mountains behind Prague. From north to west you pursue the Erz mountain from its commencement near the Elbe to its termination near Eger. The springs originate in various places :—

1. *Hauptquelle** issues out of syenite-porphyry in the deepest part of the town, and is enclosed by brickwork.

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* Chief spring.

Two pipes conduct the water into the baignoires for men, three feet deep. The temperature of the source is 39½° Reaumur, about 120° Fahrenheit, (thus hotter than the chief spring of Gastein); in the conducting pipe the temperature is 38½ Reaumur, about 118° Fahrenheit. It furnishes more than 800,000 cubic feet of water per hour, and supplies the above-mentioned common bath and numerous separate baths.

2. *Frauenbadquelle** arises a few paces from the former, and supplies the baths for females; those for ladies and those for women of a lower class being separated by a wall. Its temperature is 38½° Reaumur at the issue, and 36° in the basin, its supply more than 400,000 cubic feet per hour.

3. *Frauenzimmerbadquelle,*† near the former, temperature 36° to 38½° Reaumur.

4. The *Sandbadquelle,*‡ east of the former, temperature 35° Reaumur.

5. The *Garden springs* arising in the 'Spitalgarden,' and having a temperature of 20° to 21° Reaumur, Trinkquelle, Augenquelle, and Badequelle (drinking, eye, and bath spring). They yield 66,000 cubic feet of water per hour. The village of Schönau possesses, 1. *Steinbadquelle,*§ lying on meadow ground at the foot of the Schönauer mountain; its temperature is 30° Reaumur, and its supply 500 cubic feet per hour. 2. *Tempelbadquelle.*‖ 3. *Wiesenquelle,* (meadow spring). 4. *Militärbadquelle.* 5. *Schlangenbadquelle,* (spring of serpent's-bath.) Temperature of the last three from 28° to 32° Reaumur. *Neubadquelle,* (spring of the new bath), formerly called sulphur-bath spring, with 35° Reaumur; and, 7. *Sandquelle,* with a temperature of 34° Reaumur. For bathing, part of the water is cooled in reservoirs, and mixed with the thermal water. The water of the chief spring exhibits a green appearance in the basin, but becomes clear and transparent when drawn. It is

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* Spring of the ladies' bath.

† Spring for females.

‡ Sand-bath spring.

§ The stone-bath spring.

‖ Temple-bath spring.

inodorous and tasteless. In cooling, carbonate of iron is found deposited in the conducting-pipes. Exposed to the atmosphere, crenic acid separates as a sort of mucus, and afterwards the so-called Priestley's green matter developes itself and becomes transformed into oscillatoria. The springs greatly resemble each other as regards their chemical constituents. Carbonate of soda is the prevailing ingredient, and amongst the gaseous contents nitrogen is either evolved in a free state (in the sand, stone, and serpent's bath), or intimately connected with the water in the others. The chief source contains in sixteen ounces,

0·43	grains of	sulphate of potash.
2·68	,,	carbonate of soda.
0·01	,,	carbonate of lithia.
0·32	,,	carbonate of lime.
0·01	,,	carbonate of strontia.
0·08	,,	carbonate of manganese.
0·05	,,	carbonate of magnesia.
0·03	,,	carbonate of iron.
0·43	,,	chloride of sodium.
0·10	,,	chloride of potassium.
0·05	,,	iodide of potassium.
0·02	,,	phosphate of alumina.
0·13	,,	silico fluoride of sodium.
0·31	,,	silica.
0·09	,,	*crenic acid.*
4·84—thus rather less than 5 grains.		

Carbonic acid, 0·39 cubic inches. *Nitrogen, 0·49, or about half an inch.*

In 100 parts of gas, the Stadtbadquelle contains about 4·7 of carbonic acid, 0·6 of oxygen, and more than 94·5 of nitrogen. This will remind you of the proportions observed at Wildbad. In former times, only the baths were employed, but latterly, drinking is frequently added to the external course. Peat-baths are also employed since 1835. The peat is dark-brown, of an unctuous touch, tasteless, and of a bituminous smell. It contains sulphate, muriate, and humate of soda, lime, magnesia, iron, and other bases, with a great quantity of extractive substance and humus. This carbonaceous peat is dried, then mixed with thermal water into a sort of pap, and employed of a different temperature, according to prescription, in moveable baignoires ; a common thermal bath is immediately taken after emerging from the peat. Teplitz is found very efficacious in chronic rheumatism, in *anomalous gout*, with swellings and contractions, in induration of the cellular tissue, in paralysis and stiffness from wounds; also in paralytic diseases, from metastatic eruptions. A very strengthening power is likewise ascribed to the spa in derangement of the sexual system, and a regulating influence in abnormal catamenial, and hæmorrhoidal flux.

During my visit last year, the cure of a Dresden physician from paralysis as a consequence of typhus fever, created so deep an impression, that I am induced to enter into some particulars. Dr. Wengler relates, in his '*Words of Consolation for Paralytics*,' that, falling ill in 1848, he was induced to take an emetic. Not finding the expected relief, he resorted to the country by the advice of Professor von Ammon, of Dresden. The disease soon assumed a typhous character. For four months he was confined to his bed. Six others in the same family were seized with typhus. His sister, nineteen years of age, died. In the beginning of 1849 the doctor's consciousness returned, and then he learned that, during four months, he had mostly lain in delirium, and that his life had been frequently in imminent danger from apoplexy. *He found his legs and one arm paralysed;* he could neither stand nor walk, nor was he able to sit with ease. As soon as summer approached, he was wheeled about in a chair for the benefit of the air. In April he resorted to Teplitz, under the advice of Dr. Schmelkes, a highly respected resident spa physician. Neither in the pelvic region nor in the vertebral column did he feel any pressure or pain. Nutrition of the thighs was still deficient. But he could now bend and extend his legs; three months before he had always involuntarily bent the thighs, and brought to consciousness, he had been unable to extend them. Emaciation was greater on the right side;

the extensor muscles of the foot were considerably atrophied; the feet were swollen, particularly on the dorsal surface; the toes were bent inwards, so that he could not place the whole sole of the foot on the ground. Professor von Ammon had therefore stated it as his opinion, *that effusion had taken place at the lower part of the spinal marrow,* and was exercising pressure on the nerves of the lower extremities. The Professor particularly thought the ischiatic nerve affected. Dr. Schmelkes recommended the town baths, and procured a convenient residence for him in the Herrenhaus, where the warmed corridors prevented his taking cold whilst being wheeled to the baths, which he began the second day after his arrival, with a temperature of 28° Reaumur (95° Fahrenheit) for twenty minutes. During immersion the affected parts were rubbed with a long-handled brush. After the bath he was placed in bed again (with the injunction of avoiding sleep), and allowed some Hungarian wine for his second breakfast. He was wheeled about in the air from noon till evening, and then allowed to recline on the sofa. After three weeks, the temperature of the baths was fixed at 29° Reaumur, $=97\frac{1}{4}$ Fahrenheit, and on the 13th of May the first douche-bath to the spine was administered, under Dr. Schmelke's personal inspection. Whilst the whole back became rose red, a small place between the second and third dorsal vertebra assumed *a bluish-red* colour, probably indicating the spot where the effusion had taken place, the absorption of which was now the chief task. The discolouration was greater at the right side.

He took one douche-bath every other day, and afterwards at various intervals; altogether, within two and a half months, nineteen douche and twenty-six general baths. Towards the end of June he returned home, with his mental faculties improved, the previous irritation and tickling of the larynx, with cough, was quite gone, the bowels were regular, and the urine was passed without difficulty. The right upper arm could be moved a little more freely, and the lower extremities were stronger. An eruption had appeared at the back of the foot, of an eczematous character, with small desquamations. Afterwards suppuration took place under both great toes, destroying the nails, which, however, were regenerated within six weeks. After about a week's sojourn at home, he succeeded in turning himself, and remaining a few minutes erect on his knees. Subsequently he resorted to the electro-magnetic rotatory apparatus of Kiel for a quarter of an hour every other day, and then every day, altogether twenty-six times. Afterwards he employed *ant vapour-baths*, by causing an ant-hill to be dug up, and the ants to be covered in a vessel with boiling water. The vapours passing along his legs, caused a pricking sensation, and abundant local perspiration. He now tried crutches, but unsuccessfully; the feet hung down helplessly, and the hands became numbed from the pressure on the axillary nerves.

The following spring he again resorted to Teplitz. Baths of 29° Reaumur were at once taken without douches, but the patient used thermal foot-baths of 35° Reaumur. Double armed crutches were now tried (distributing the weight to the hands), and this time with success. After every ten to twenty paces, the attendant had to support him with his knees, at first, to prevent his falling. At the expiration of four weeks, crutches were the only assistance required. During this stay the doctor took cognizance of the following cases:—A gentleman, thirty-four years of age, *from Zwickau*, whose hands and feet became paralysed in consequence of taking a cold river bath during a heated state of the skin, was considerably improved after a six weeks' course, and able to make some use of the injured limbs. But the spa afforded little relief in paralysis of the feet, hands, and neck, occurring in the case of a young lady *of Brunswick*, where nodous gout was considered to be the cause of the evil. In another case of paraplegia of the lower extremities of a *lady from Pilsen*, caused by the death of a married sister, and other depressing misfortunes, the baths of Teplitz had not, at the time of the doctor's departure, exhibited any good effects. But in another case, great benefit resulted from their use. A government *employé from*

Berlin, had used the cold water cure for ischias rheumatica, and had received in exchange for his previous complaint chronic inflammation of both the knees, with considerable effusion, preventing extension of the thighs; walking and standing were thus rendered impossible. When this patient left Teplitz with the doctor, after a course of the baths, the swelling of the knees was considerably diminished, and he could walk with two sticks. Dr. Wengler returned to Dresden, after three weeks' residence with his family. Recovery proceeded so rapidly, that in a fortnight he could dispense with crutches, exchanging them for a hooked stick. In the middle of January, 1850, he could ascend the stairs without holding the balusters, and a week later he could descend them without assistance. Subsequently, for about six weeks, he used an embrocation, composed of *tincture of nux vomica,* with compound *camphor liniment,* which was rubbed into the lower part of the spine. Afterwards turpentine and other external remedies were used for two months.

In April, 1850, he again sought the spa, from which he had derived so much advantage. On the 5th of May, he took the first bath, of 29° Reaumur as before, and after twenty minutes he kept his feet for a few minutes in water of 34° Reaumur (about 109° Fahrenheit). After a few weeks' course, he ascended the Königshöhe, and, to his great surprise, reached the summit without assistance or mishap, and enjoyed the view of the charming valley at his feet. The doctor was rejoiced to meet in this season, the lady from Pilsen, referred to above, greatly improved, and walking without assistance. But the greatest astonishment was created by the healthy appearance of the gentleman from Zwickau, whom the doctor scarcely recognised. He also met the employé from Berlin, very much improved, but less so than the Zwickau gentleman.

During a two months' sojourn, the doctor had used forty-eight baths, and two douche baths: the latter had caused considerable aching pains in his great toe, and were therefore discontinued. He found himself now perfectly well, with the following exceptions: the feet occasionally swollen; the skin very susceptible; remains of nervous contraction diminished, but still great pain in the toes after long exertion. He could walk half an hour without fatigue. After his return to Dresden, he was seized with violent pains in the great toes, the seat of the nervous contraction. Inflammation and suppuration took place under the toe of the right foot. But this great suffering was compensated by an increasing straight direction of the toes, and by decisive efforts of the extensor muscles to heighten the mobility. At last he found that the nail had inserted itself a quarter of an inch into the flesh. It was drawn out with pincers, and after the inflammation had subsided, his step became daily firmer and more erect.

Perhaps you may question the utility of the above details, and think the mere statement of the disease might have answered the same purpose.

But, Gentlemen, in such compound action of remedial, climatic, dietetic, and mental influences, I consider well-authenticated cases of the utmost value, nay, indispensable for the proper appreciation of the respective curative agencies.

Diseases that will yield to specifics may well confirm the efficacy of remedies by mere enumeration. Derangements of the nervous system, however, induced by such a variety of heterogeneous causes, or *abnormities* of other organs, and requiring such various corresponding modes of treatment, may be considered almost in each case as special disorders. Let us subject the remarks of the doctor to some examination.

It will be admitted that a well-established instance of *paralysis from typhus fever* has been chiefly cured through the power of Teplitz. We have also seen paralysis, through the sudden effect of cold, cured by the same agency; and thirdly, metastatic inflammation of the knees, accompanied with effusion, greatly improved, whilst no perceptible effect was perceived in paralysis of the lower extremities from nodous gout. I may take occasion to observe, that according to the view I offered in the lecture on Wildbad, the latter case was peculiarly fitted for the Wurtemberg spa, where the combined influence of chloride of sodium and nitrogen might have brought about a result unobtainable at Teplitz, however multifarious the range of indications may be for the Bohemian akratotherma. Taking into account the effect we may expect from thermal water penetrating the absorbent vessels and adding carbonate of soda and of lime with some chloride of sodium to the circulating fluids, we may distinguish cases requiring the spa with predominant carbonate of soda (Teplitz). The nervous system having, in the case of Dr. Wengler, lain so long in comparative prostration with the attendant irritation of the alimentary mucous membrane, the sodaic liquid in the first instance diminished the gastric irritability by neutralizing its acidity. In the next place it improved the renal function by diminishing the oxygenating tendency of the blood, consequently the excessive formation of uric acid. We saw improved vesical action in the first course. By thus indirectly promoting fluidity of the nutrient liquid, the reflux of venous blood must become facilitated; add to this the local irritation resulting from the douche, favourable to an improved cutaneous innervation, and at the same time forming a revulsive from the internal affection, and you will require no mysterious agency to obtain a satisfactory explanation of the cure brought to your notice, and a sure indication will be given for analogous instances.

The case of paralysis through the cold bath will admit of a similar explanation. In the third case of metastatic inflammation, through the slow action of cold, we have already witnessed a less degree of efficacy. The improved action of the nervous system was not sufficient to induce absorption of the exudated particles; whenever increased action of the absorbents is desirable the patient should choose Wildbad. It is highly improbable that four spas should be equally curative, while they each possess different ingredients in predominance, viz., one chloride of sodium, another carbonate of magnesia, a third sulphate of soda, and a fourth carbonate of soda.

You will find that the other points which I have still to mention concerning Teplitz, quite agree with the views I have ventured to lay before you.

As regards the temperature of the baths, it is necessary to guard against using the hotter ones improperly. Those of Schönau are preferred where cooler baths are required. As a general rule, it is advisable always to begin with the cooler baths, and then rise in the temperature with great care and circumspection, if demanded by the morbid phenomena. I need not state that plethoric persons, or those inclined to apoplexy, to congestion, or to obstipation, have to avoid the warmer baths, and often to avoid the spa altogether. As also persons with erethric weakness, or tendency to thoracic affections. Torpid and phlegmatic individuals will bear the warmer baths better. The country people always prefer the higher temperature, and resort to cupping, in order to guard against mischievous consequences. The danger of this habit is too obvious to require further comment. Drs. Berthold, Hofman, v. Hofmanthal, Richter, Willigk, and several other highly respectable physicians, practise at the spa, besides the physician mentioned in Dr. Wengler's case. After Carlsbad, Teplitz is very frequently resorted to as an after-cure. Some, by the advice of their physicians, others from their own accord, seek in Teplitz restoration and invigoration, after having undergone a somewhat weakening course of Carlsbad in cases of obstinate obstruction of the liver, lithiasis, or gout. Unfortunately, this class of patients consider themselves justified, nay called upon, to live freely and indulge in the luxuries of the table, which were denied them by the strict dietetic rules necessary at Carlsbad. Carelessness in drinking cold beverages after different sorts of fruit is one of the most frequent occurrences.

At my visit last year, the cholera had suddenly broken out (in August), and carried off several victims very rapidly, and, strange to say, almost exclusively those who had previously used one or other of the pikrothermæ. This caused such a panic that the place was cleared of its numerous fashionable and unfashionable visitors in a very short time; at the height of the season. Still every death was clearly traceable to the sufferer's own intemperance or want of caution, and especially to the habit just referred to. Not one of the inhabitants was seized by that formidable disease, which overtook so unwarily some of the more prominent personages, and destroyed several lives very rapidly. Both from medical and philanthropic reasons, I felt extremely gratified to find confirmation of the notion forced upon me by the observation of the epidemic in London, viz., that no disease can be prevented with more safety and certainty than cholera, and, above all, that unguardedness, especially in drinking, is one of the most frequent, if not absolutely the chief provocative of the disease. At least I found, in my limited experience, those cases the most virulent which could be traced to the cause alluded to, whilst, on the other hand, the mere eating of even indigestible or excessive nutriment had not the power of producing that mysterious disease, which has so long baffled all known methodical modes of treatment. But I consider it a great consolation for our profession, that though no efforts, nor ingenuity of science, could discover a specific, we have at least acquired by experience the negative knowledge that certain remedies will *not* combat the evil, whilst well-defined precautions will positively guard against it. According to my own belief, it is quite impossible that a specific should ever be found against cholera. From the various cases that have fallen under my observation, I could not help coming to the conclusion, that the disease was not only different in different individuals, but that in the same patient you have a series of perfectly distinct, and I might almost say opposite morbid phenomena before you, which so vary in their nature, that a remedy curative of the one series must be rationally considered useless or even injurious to the other. For instance, I have found the stage of collapse (where the extremities exhibit an icy coldness, the face a livid hue, and the wrists absence of or scarcely perceptible pulsation), a disease in which the constant vomiting and purging are not only not to be checked, but this violent intestinal irritation seems actually an effort of nature to fix the vitality, and prevent its flagging away under the intense prostration of the whole nervous system. During this period such remedies only can be of any avail, which tend *to restore vitality* and animation without the slightest regard to the tumultuous alvine action. But the means answering their purpose in this stage will be quite useless in the next, when more vitality has been recalled, and reaction commenced. *Now* the morbidity of the abdominal phenomena demands urgent removal. There is not the slightest doubt that this circumstance caused so many conflicting reports, and such sad disappointments from every possible remedy suggested. But let it be a fixed rule, Gentlemen, with you, if ever the epidemic should unfortunately revisit this island, that specifics, recommended by whatever authority, are based on delusion too soon to be dissipated, and if you desire to spend the utmost mental and physical energy in conquering the almost invincible enemy, consider the patient with an unbiassed mind, with a perfect disregard of lauded specifics, and even of the name of the disease; observe the morbid phenomena, and counteract them out of the ordinary store of healing agents at your command. But to insure success the patient must be seen at very short intervals, and the remedies varied according to the above rule. What I state to you here, Gentlemen, is not mere theory, but the digest of observed facts, and it was God's will that under this method several cases were cured, where no hope of recovery existed at the outset.

I hope, Gentlemen, that I shall require no apology for having introduced this or other important subjects, apparently extraneous to our course. Observations tending to lessen in the slightest degree the manifold difficulties that will cross your path in the practical recognition and treatment of disease, will perhaps not be thought by you quite superfluous in after life.

LECTURE VIII.

PIKROPEGÆ.—CARLSBAD.

GENTLEMEN,—The neighbourhood of the spa treated of in our last lecture, leads us to the consideration of another class of mineral waters, viz., to that of the Pikropegæ (bitter springs), from πικρος, bitter, and πηγη, spring), characterized by the predominance of sulphate of magnesia, or of soda, which imparts to them a bitterish and sometimes a nauseous taste. The abundance of free carbonic acid removes the mawkishness or nausea of some, whilst heat modifies the flavour in others. Generally they are transparent and colourless; small quantities of atmospheric air or carbonic acid are found in most of them, rarely traces of sulphuretted hydrogen.

They are called *pikrothermæ*, if warm or hot (from πικρος, bitter, and θερμος, hot), and possess a taste similar to that of chicken broth, like the weaker halothermæ; and pikrokrenæ, if cold (from πικρος, bitter, and κρήνη, adopted as the appellation for cold springs). The alkaline bitter waters display a less bitter and mawkish taste than the earthy, particularly if impregnated with a sufficient amount of free carbonic acid; for instance, Franzensbad. Contact with organic substances, pieces of straw, &c., whilst the bottles are filling, easily produces decomposition and evolution of sulphuretted hydrogen gas.

The pikropegæ originate in volcanic mountains, or in strata of marl, sometimes in secondary layers of gypsum. Their general effect consists in depression of the organic vitality, and they are, therefore, indicated in cases of general irritability, with obstructed abdominal circulation. Of course admixture of iron, or other metals, modifies this result to a considerable degree.

Co-existence of carbonate of soda in the same spring, causes a very powerful combined alterative action on sanguification. From its vicinity to Teplitz, our next visit is claimed by *Bilin,* which we may inspect before reaching the pikropegæ. It is a little town, of nearly 3,000 inhabitants, situated on the river Bila, which meanders through the Middel-mountain, and then enters the Elbe near Aussig. Gneiss forms the foundation of the mountain masses, superposed by stratified trap rock, consisting of klingstone, porphyry, and basalt. The Biliner Stein or Borczen, to the south, affords a very extensive and agreeable prospect. The springs are situated about half a league from the town, at the eastern declivity of the Ganghof. In wandering through the shady walk which leads to the springs, you pass on your left the laboratory, in which magnesia is prepared in large quantities from the chemical interchange between the sulphate of magnesia of Saidschütz, and the carbonate of soda of the Bilin spring. The soda of the concentrated Bilin water combining with the sulphuric acid of that of Saidschütz for the formation of sulphate of soda, carbonate of magnesia separates. These works yield a large income to the proprietor (Prince Lobkowitz). Behind the Arhaus, on the right, you descend by stone steps to the chief spring *Josephsquelle;* the water is clear and sparkling, with an agreeable pungent taste; temperature, 9° Reaumur (52° Fahrenheit), specific gravity, 1,006. In the abundance of carbonate of soda, it surpasses all German springs, (Vichy, in France, possesses a larger quantity). Analysis, according to Struve, shows it to possess 38 grains of solid constituents in 16 ounces, viz.:—

		Comparison with Teplitz.
22·73	gr. of carbonate of soda	2·68
3·06	,, ,, lime	0·49
1·19	,, ,, magnesia	0·28
6·17	sulphate of soda	0·54
2·88	chloride of sodium	0·42
1·73	sulphate of potash	0·43
0·02	basic phosphate of alumina	0·02

	Comparison with Teplitz.
0·35 silex	0·31
Traces of strontia and iron,	carb. ir. 0·03 strontia 0·01
Carbonic acid 33½ cubic in.	

A great analogy therefore exists between the two as regards quality.

The water is more drunk at other places than at its source, upwards of 90,000 bottles being annually exported. The other springs—Carolinenquelle, Quelle im Gewölbe (spring in the vault), and Gemeinquelle (common spring), are very similar. Compared with *Selters* water it has the advantage of possessing 16 grains more of carbonate of soda, but the latter from its greater quantity of chloride of sodium (17 grains in 16 ounces) has a more agreeable taste, and deserves the preference whenever the properties of the latter salt are more called into requisition.

Fachingen water bears a great resemblance to Bilin, having only five grains less of carbonate of soda, and about two more of common salt.

Geilnau, which is also frequently used as an alkaline water, contains only 11¼ grains of solid constituents, and of these only six are carbonate of soda, two carbonate of magnesia, and two of lime. *Heppingen* contains the same quantity of carbonate of soda, of magnesia, and of lime, but has in addition three grains of common salt and two of soda (altogether fifteen grains), and thus its efficacy holds an intermediate position between Fachingen and Geilnau.

Without further dwelling on the medical properties of Bilin, which are those of carbonate of soda, referred to in the last lecture, we pursue our course to the south and inspect Saidschütz, situated two leagues to the south-east of Bilin, in the eastern part of the plain of the bitter waters. Deep ditches are dug into the marl, composed of basalt, quartz sand, and carbonate of lime. These gradually fill with atmospheric water, and get impregnated with the soluble parts of their earthy beds. The drier the season, the more concentrated will be their contents.

Before being medicinally employed, these nauseous waters were known in the neighbourhood under the denomination of "Laxir, Fress, or Fieberwasser" (purging, appetite making, or fever water).

Saidschütz, enjoying a higher situation, is less exposed to the influx of meteoric water than its westerly neighbour, Seidlitz; and thus its greater abundance of solid ingredients is accounted for. The ridge, gently sinking from Krssina to the Serpina bog, encloses the limited locality of these bitter springs. Saidschütz contains in sixteen ounces 178 grains (nearly three drachms) of solid constituents—viz.

46¾	grains of	sulphate of soda,
84	,,	sulphate of magnesia,
10	,,	sulphate of lime,
2	,,	chloride of magnesium,
5	,,	carbonate of magnesia,
1	,,	crenate of magnesia,
25	,,	nitrate of magnesia,
3-100	,,	iodide of magnesium.

You have then sulphate of magnesia as the chief ingredient, with about half the quantity of sulphate of soda and nearly a third of nitrate of magnesia. Its property as a solvent, aperient, cooling and antiphlogistic remedy is too obvious from its composition to require any further explanation. Saidschütz salt is prepared by concentration, crystallisation, and separation of the sulphate of magnesia, by means of its greater solubility. It is obtained in the shops under the name of bitter salt, or more commonly under that of "Englisches Salz" (English salt). *Seidlitz,* about half-an-hour's walk to the north-west of Saidschütz, contains only 126 grains of solid ingredients in sixteen ounces (nearly a drachm less than Saidschütz), viz., no sulphate of soda; 104 grains of sulphate of magnesia; eight grains of sulphate of lime; three grains of chloride of magnesium; three grains of carbonate of magnesia; eight grains of carbonate of lime (none contained in Saidschütz); no silex; no nitrate of magnesia.

Analogous to the composition of Saidschütz, it exerts a less aperient power, its sulphates being less in quantity and partially counteracted by the presence of carbonate of lime. The absence of the antiplastic nitrate renders it a still weaker agent in counteracting congestive fulness of internal organs. The real Seidlitz powder, which I have prepared for this lecture, by evaporation, you will find vastly different from the pleasant and refreshing Seidlitz powder sold in commerce, with the alkali in white and the acid in blue paper, and consisting of triple tartrate of potash and soda.

Püllna, the furthest to the west, lies on the road to Carlsbad, and possesses several enclosed wells; only one, however, is used, being of such abundance, that 6,000 small bottles might be filled weekly with it. The above three waters are remarkable for their disagreeably bitter taste and their yellowish tint. When drawn, they are clear and transparent. Drunk at the springs, the nausea is partially diminished through the somewhat greater proportion of carbonic acid. When used at a distance, I always find the effect increased, and the assimilation of the water facilitated, by adding an equal quantity of hot water to that medicinally required. Püllna contains in 16 ounces 251 grains, (nearly 4 scruples more than Saidschütz); viz., 123 grains of sulphate of soda (about 4 scruples more than Saidschütz); 93 grains of sulphate of magnesia; 4¾ grains of sulphate of potash (none contained in Saidschütz or Seidlitz); 2½ grains of sulphate of lime; 19½ grains of chloride of magnesium (only two in Saidschütz); 6½ grains of carbonate of magnesia; ¾ grain of carbonate of lime; 17-100ths grain of silex; no nitrate of magnesia; no iodide of magnesium. This analysis at once informs you of its greater power as a derivative, aperient, and solvent, than the two former.

Before leaving the subject of the bitter waters, which are rather to be classed as medical beverages than as mineral springs, allow me to bring to your notice *a fourth,* also frequently employed in analogous cases, though its origin lies some distance from the spot which we are treating of at present. I allude to the *saline bitter water of Friedrichshall,* in the dukedom of Saxen-Meiningen, near the village of Lindenau, four leagues distant from Coburg, five from Hildburghausen, and nine from Bamberg. The place has been noted for its salt-works for several centuries. Glauber-salt was obtained from the brine, under the appellation of *sal aperitivum Fridericianum. Dr. Bartenstein,* of Hildburghausen, has caused the water to be employed since 1843. To approximate its strength to that of Püllna, it is concentrated by graduating works and filtering processes, and not exported till its specific gravity amounts to 1,022 at 10° Reaumur. The water is clear and transparent, and contains in sixteen ounces 194¼ grains of solid constituents (nearly a drachm less than Püllna, and a scruple more than Saidschütz), viz., 46½ grs. of sulphate of soda, 39½ sulphate of magnesia, 1½ sulphate of potash, 10⅓ of sulphate of lime, 30¼ chloride of magnesium (half a scruple more than Püllna), 3 1-10th carbonate of magnesia, 1-10th carbonate of lime.

Besides the above, bearing analogy to the Bohemian bitter waters, it contains 8-10ths of bromide of magnesium, 61 1-10th grains of chloride of sodium, and 5 cubic inches of carbonic acid.

If, then, the bitter waters are generally useful in indigestion, in deficient alvine secretions, in abnormal bilification, obstruction and torpor of the alimentary canal, in plethora and venous dyscrasia, in thoracic or cerebral congestion, Dr. Bartenstein considers the water of Friedrichshall, from its chlorides, particularly appropriate in various diseases of nutrition, where Püllna would exert a too lowering influence. He found it very useful in dyspepsia, even connected with inflammatory irritation of the stomach, when taken in small doses of two to three wine-glasses full, at shorter or longer intervals; in erethric gastrodynia, &c. Even in pyloric induration, he witnessed vomiting diminished by the water taken in doses of a tablespoonful. He also recommends it in flatulence, acidity, and the spasms of childhood, arising from irritation during difficult dentition, in mucosity of the pulmonary mucous membrane, and in hysteria and hypochondria, based on abdominal obstructions; in chronic swellings of the spleen he observed rapid cures by a course of the water in small quantities; also in hepatic hypertrophy, after a long continued intermittent fever. For the habitual venesections of many persons, to counteract apoplectic tendency, the water may be safely substituted. He considers it as holding an intermediate position between the bitter and more tonic saline waters. I have had no opportunity of testing its efficacy, it having only very recently been introduced here, but its composition is such that appropriate cases must frequently occur, where its employment promises useful results. Its happy combination of chloride of sodium, of magnesium, and bromine, with the sulphates of soda and magnesia, allows us to expect a combined solvent, alterative, and aperient efficacy.

Carlsbad.—But let us proceed on our journey. If you desire to travel uninterruptedly from Teplitz to Carlsbad, you may leave at eight p.m. by the eilwagen, and in thirteen hours (nine next morning) you will reach the so-called king of the German spas. Carlsbad is situated latitude 50, longitude east 13, in the Elnbogner Kreis, of Bohemia, on both sides the Tepl river, in a narrow deep valley, which extends from south to north, at an elevation of 1100 feet above the level of the North Sea, eighty miles to the west of Prague, ninety to the south-west of Dresden, sixty-five miles to the south-west of Teplitz.

You see the river Tepl (which means in Bohemian, the "warm one") originate in the south above Marienbad, about fifty latitude, and entering the Eger river in the north. Carlsbad, a charming little town of 3000 inhabitants, allows free access to the north winds, as you will perceive from its situation; the temperature is therefore subject to sudden changes, though the climate is generally temperate. You also see the valley devoid of mountainous enclosure in the west. The discovery of the spa is ascribed to a dog of the Emperor Charles IV., who, about four and a half centuries ago, when in pursuit of a stag, leaped into a spring, and attracted the huntsmen by its painful howlings. When they arrived, they found him in the hot spring, now called "Sprudel" (Bubbler), because its steaming liquid constantly rises and falls with a hissing noise. The spot from which that famous leap is said to have taken place, assumed the name of "Hirschensprung" (stag's leap) to the west of the town.

To the south, you remark the Hammerberg; to the north-east, the Kreuzberg, on the other side of the Tepl. These are the highest mountains. The Laurenz Mountain, or Tappen, to the east, and Galgen Mountain, to the north, are somewhat lower. The rocks consist chiefly of granite. The Schlossberg, leaning on the Hirschenstein, is composed of horn-stone. Immense masses of volcanic origin reach from Schlackenwerth to Engenwall. About a quarter of a league below Carlsbad, the valley widens and allows the Tepl to pour its contents into the Eger river.* The road to Carlsbad from the height (if coming from Prague) makes a sombre and yet a grand impression, as you descend into the deep basin. From the western Eger you enter on a plain; both roads join at the Franzensbrücke, and conduct you into Carlsbad on the right shore of the Tepl, where, also, the sprudel takes its origin. Many bridges join the two parts of the town. The streets are generally narrow, with the exception of those called "Wiesen" (meadows). Poor patients are provided for, without distinction of country or religion, in the hospital built at the foot of the Bernhard rock. The environs of Carlsbad are most charming. Picturesque and wild scenery constantly alternates with beautiful park-like clusters of trees; green meadows, with woody hills; dark, shady walks, with widely-spread open prospects. By the "Puppische Allee," a gravel foot-path leads you to the walks on the ridge and declivity of the Hammerberg on the right, and Laurenzberg on the left. From the "Neue Wiese," an excellent carriage road brings you to the villages of Hammer and Aich, with the rapid Tepl between them.

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* Which arises in the west, running eastward between Franzensbad and Eger, then between Maria Kulm and Konigsberg: passing to the north of Carlsbad, it pursues for some time a parallel course with the Bila, and then joins the Elbe near Leitmeritz, between Dresden in the north and Prague in the south.

The walks to the so-called Himmel auf Erden, to the Posthof, Hirschensprung, Schiessehaus, Antonsgrube, Dichterbank, Belvedere, Augustusplatz, &c., &c., offer many pleasant views. For further excursions you are invited by the town of Elbogen (two leagues to the south-west), situated on a steep rock, and encircled by the Eger river in the form of an elbow (hence its name of Elbogen, which signifies elbow); to the city of Schlackenwall (a league to the south of Elbogen), with its lead and tin mines, and to Joachimsthal (four leagues from Carlsbad), where silver mines were worked in the sixteenth century. The ruins of Engelhaus, on the summit of a high rock, on the road to Prague (two leagues to the east of Carlsbad), and many other places, furnish a great variety of inducements for pedestrian or carriage exercise.

The springs issue out of lime-stone, into which wooden pipes are fixed to distribute and equalize the proportion of the rising fluid. This lime-stone is formed by the water itself, which deposits calcareous sinter in proportion as it loses its carbonic acid. These stony masses extend from one bank of the Tepl to the other, in the middle of the town, and supply foundations for many houses. Wherever you break through these stony coverings, hot water issues. The petrification lies deeper on the right shore, being more particularly fed by the hot source. Out of six apertures the sprudel water issues with a temperature of 59° Reaumur, = 165$\frac{3}{4}$° Fahrenheit, five being near each other, and the sixth, more distant, is the Hygiaeensquelle. About fifteen yards further, in the bed of the Tepl, a larger hole is bored into the sprudel-crust, and provided with a plug, which is only removed on certain occasions. The above openings are walled in, being situated below the level of the Tepl. The wall supports a boarded enclosure, in which you find the chief source, called the Sprudel or Springer (jumper), the water spontaneously jerking upwards in a perpendicular tube, which rises one yard above the boards, and has a diameter of three inches; the height of the water-column from the ground amounts to four yards. About nineteen times a minute, the water jumps up and sinks again. This arises from the accumulation of carbonic acid in the upper parts of the sprudel-basin. Its gradually increased expansive power at last breaks a wider passage through the water, which becomes pressed down, in consequence, to admit the issue of the carbonic acid from the water-pipe. As soon as this is partially diffused, and diminished on the surface, the water is allowed free scope to rise again, and thus the process continues, emitting alternately carbonic acid and water. The jerks are not all of equal power; generally after eight or ten weaker and quicker discharges, a stronger and more abundant one ensues, with an accompanying dull subterranean hissing. If the plug be removed from the deeper artificial borehole fixed in the Tepl, only gas escapes from the Sprudel, without any water. The other Sprudel-openings are covered by boards, and can, therefore, not be seen. The constantly deposited sinter accumulates to such an extent, that the holes must be bored out four times a-year to prevent their being closed, and inducing sprudel-eruptions in consequence. In former times these eruptions were more frequent than now, less attention having been paid to the safety holes. One of the most violent happened on the 2nd of September, 1809. On the night of the 1st of September the Sprudel began all at once to jerk its water up with great violence to the height of the wooden ceiling. Removal of the plug in the safety hole induced a quiet flow again. Some hours, however, after the plug had been refastened, the next day (2nd of September) the Sprudel covering broke in several places, and a new Sprudel (hygiaeensquelle) with the same heat, but more abundant and powerful than the former, issued forth, throwing the water to a height of eight or nine feet. Fissures also appeared in the pavement near the Sprudel, which had ceased to throw its water up, and emit the usual subterranean hissing. The more distant Schlossbrunnen flowed with less abundance and with diminished temperature, and at last ceased entirely. The new 'Springer' found about fifteen yards from its predecessor, beyond the 'sprudel wall,' continued to jerk to the above-mentioned height till its opening was considerably widened, and provided with a large pipe, by which the original spring was restored to its former force, so that the *parvenu* now only flows over alternately, and has scarcely a claim to the title of 'Sprudel.'

The *Schlossbrunnen,* reappearing in 1823 (fourteen years after having vanished) with the decreased temperature of 27° Reaumur at first, but having now again 36° Reaumur, (113° Fahrenheit,) lies furthest away from the Tepl, and issues out of a rocky ground at a more considerable height than the others. This greater distance from the common source out of which all the springs are supposed to arise, accounts for its diminished temperature. The *Mühlbrunnen* lies in a dark corner on the other side of the Tepl, about 400 yards from the Sprudel at the foot of the Schlossberg opposite the Mühlbad-bridge—temperature, 45° Reaumur (132¼° Fahrenheit). A colonnade extends from this spot along the bank of the river as far as the Bernhard rock; this spring is much used for drinking. About thirty yards further we perceive the *Neubrunnen,* of the temperature of 49° Reaumur, 141° Fahrenheit. From the stairs that lead to the Wandelbahn (promenading path) you descend on the left to the *Bernhard's brunnen,* the hottest in this region, its temperature amounting to 54½° Reaumur, 153° Fahrenheit (12° Fahrenheit warmer than the Neubrunnen). Ascending some stairs from the colonnade we observe the *Theresienbrunnen* (formerly called the Gartenbrunnen), with a pleasant shady walk, bordered by lime trees. Temperature, 42° Reaumur, 126½° Fahrenheit (formerly 45° Reaumur). Quite at the end of the town, behind the hospital, and on the declivity of the Bernhard rock, the *Spitalbrunnen* originates, but is only used for baths. Temperature of the upper spring, 35° Reaumur (110¾° Fahrenheit), and of the lower, 27° Reaumur. In 1838, a new spring made its appearance; the *Marktbrunnen,* with a temperature of 43½°, about 130° Fahrenheit; and as late as 1844, a mineral source arose below the Bernhard rock, and was named *Stephan's brunnen.* Its present temperature is 44° Reaumur (131° Fahrenheit). The freshly-drawn water of all the springs is perfectly clear, transparent, and inodorous, tasting like weak chicken broth. Exposed to the air, it assumes a milky appearance, and deposits on the surface a whitish pellicle (bath-foam), and after some time a yellowish precipitate sinks to the bottom, upon which the bath affords a more lixivious odour. The water of the Mühl and Theresienbrunnen sparkles more than the others. As regards the quantity of the hot liquid poured out by the respective springs, the Sprudel yields annually seventy millions of cubic feet; the Bernhard's brunnen, 800,000; the Neubrunnen, 71,000; the Mühlbrunnen, 41,000; the Theresienbrunnen, 19,000 cubic feet. With reference to the constituents of the various springs, the same proportions are maintained in all of them, thus proving a common origin, whilst the higher or lower temperature is due to their deeper or more elevated issues. The mouth of the Sprudel being nearest to the subterranean caldron, exhibits the highest temperature, viz., 59° Reaumur (21° below the boiling point). The Bernhard's brunnen having a lower situation than all the others, after the two Sprudels, possesses a corresponding higher temperature, viz., 54½° Reaumur (only 5° Reaumur less than the Sprudel). The same proportion is shown in the Neubrunnen and Theresienbrunnen, the two last named lying just below each other, and possessing respectively the temperature of 49° and 42° Reaumur. The Sprudel contains 41·92 grains of solid constituents in sixteen ounces, viz., 19·86 sulphate of soda (about half of the whole amount), 9·69 carbonate of soda (about one-fourth), 7·97 chloride of sodium (about one-fifth), 2·37 carbonate of lime, 1·36 carbonate of magnesia, 0·02 carbonate of iron, 0·57 silex. Besides some carbonate of strontia 7-1000, of manganese 6-1000, phosphate of lime 1-1000, basic phosphate of alumina 2-1000, and fluoride of calcium 24-1000. Carbonic acid, 11 cubic inches; specific gravity, 1·0049. The Neubrunnen possesses 14½ cubic inches of carbonic acid, the Mühlbrunnen 15⅓ cubic inches. Theresienbrunnen 36½ grains of solid constituents in the same proportions, and 15⅓ cubic inches of carbonic acid. Bernhard's brunnen also 36½ grains of solid ingredients, and 13½ cubic inches of carbonic acid. The Schlossbrunnen contains 38½ grains of solid constituents, and amongst them 0·39 of sulphate of potash, and 2-1000 of carbonate of lithia, with 13½ cubic inches of carbonic acid. The Mühl, Theresien, and Neubrunnen, abounding most in carbonic acid, are frequently used for drinking, and exercise a less exciting influence, from the abundance of carbonic acid and from their lower temperature. The Schlossbrunnen, being cooler and not deficient in carbonic acid gas, is generally recommended for commencing the course, and is also used for exportation.

Springs of fresh and sweet water are rare about Carlsbad. As regards the Tepl, I have to add, that its fall from the source amounts to 600 feet in its short course of thirty miles. The granite rocks, from which the springs originate, are partly of a large, and partly of small granular structure. The hornstone veins, which occasionally permeate the granite, have already been alluded to. Some layers of argillaceous porphyry are found taking the same direction as the thermal springs.

The sprudel-water covers with white, brown, or yellowish incrustations all objects over which it has passed for some time. The colour depends partly on the access or exclusion of atmospheric air. In the former case, oxide of iron will make the crust darker, and in the latter it will be merely calcareous, and display a white colour. Pisoliths (peastones) are also products of the thermal water; probably grains of sand formed the nucleus round which calcareous sinter became deposited. It seems somewhat surprising, Gentlemen, that this very liquid, with its remarkable petrifying property, is the most powerful solvent in hepatic enlargements and abdominal infarcta. Tough, viscid, intestinal mucosity becomes mobilised and excreted; collected and indurated fæces are discharged; the torpid portal circulation is called into greater activity by the removal of acrid obstructing particles. The increased production of animal matter, the source of gout and lithiasis, is powerfully counteracted by the spa. The exciting effect of heat is considerably diminished by the revulsive action, which the sulphate of soda exercises on the intestinal fibres, so that common water of the same temperature as the Sprudel would cause a much higher degree of cerebral excitement and general sanguineous orgasm. The carbonate of soda contributes the chief share in the marked action on incipient lithiasis exercised by the spa. Excessive acidity of the organic juices is neutralised, formation of uric acid prevented or diminished, and thus vesical irritation allayed. The addition of chloride of sodium may chiefly perform the function of improving the digestive process by increasing the strength of the gastric juice, through the formation of hydrochloric acid, so that alkalescence cannot reach too high a degree, whilst the soda combines with the albumen of the abnormal or excessive fat, or organic pseudo-production, and prepares them for elimination. The carbonate of lime and magnesia assist the antacid and antilithic efficacy, whilst the manganese, iron, and silica, increase the tone of the intestinal fibre, and thus tend to prevent the too weakening effect of these highly-solvent and antiplastic media. Imagine these particles introduced into our organism, with the warm liquid and the accompanying volatile carbonic acid, and you will not be surprised at the remarkable changes wrought in those numerous inveterate diseases which originate in abdominal obstruction and retarded portal circulation. The highest reputation is, however, enjoyed by the spa in *hepatic or splenetic physconia,* the consequence of intermittent fever, in *colic* produced *by gallstones*, &c.; and from all parts of the globe you may see individuals with puffed-up and icteric appearance, and with unmistakeable signs of depraved bilification. Although many are cured, I need not tell you that some are disappointed, and others, particularly if resorting to the spa without due discrimination, even find their complaints aggravated, and this may especially happen, if the Sprudel be at once incautiously used, for care on this head is required, even with persons of torpid circulation. The vascular and cerebral systems often show signs of agitation, as headache, giddiness, lassitude, forgetfulness, disinclination to exertion, restlessness, loss of appetite, sickness, &c.; these phenomena sometimes appear, in a slight degree, even in phlegmatic individuals, when first using the hot springs—in fact, a sort of mild intoxication is induced. How much more, then, may we expect plethoric persons to be affected, and those disposed to cerebral congestion, apoplexy, inflammation of internal organs, or great general irritability. Such patients must, therefore, never be recommended to avail themselves of Carlsbad, though the state of their hypochondriac organs may appear urgently to demand it. Generally speaking, it is the most renowned mineral water for hypochondriasis, with material basis, or in diseases caused by repression of piles, which are made to flow, and thus relieve the system from the array of metastatic and metaschematic disorders, to which such invalids are liable. On the other hand, a person who suffered with habitual giddiness after an intermittent fever, being sent to Carlsbad, found the fever reproduced, which, however, disappeared without further medicinal means, and carried its metaschematic remnant with it. That *callus* of previously-united bones often softens again, has been established by several writers. Former wounds, or seats of gouty and rheumatic affections, become painful and appear excited for some time, till crises ensue by the bowels, skin, or kidneys, and restore the former state of health. *Anomalous gout,* connected with deficient hepatic function, is frequently cured here. Besides the states of plethora referred to above, Carlsbad is also *contra-indicated* in actual digestive atony, or in general debility, produced by loss of blood or other weakening causes, in dropsy, scorbutic tendency, in phthisis, and internal suppuration, in lithiasis with great irritation, and such large stones as cannot pass through the urethra, in organic diseases of the heart, in chlorosis, &c. Increased salivary secretion sometimes critically occurs during the course, and lasts for several days, probably caused by reciprocal influence of the stimulated pancreas. Appetite is heightened at first, but as the course proceeds, flatulence, eructation, pressure on the pit of the stomach, tickling, and stitches in the hypochondria, clammy taste in the mouth, &c., now and then take place, and only yield after the critical discharges by the bowels, skin, or kidneys have appeared.

The purging produced by Carlsbad differs from ordinary purgation, by very fetid, bilious, mucous, and fatty stools, more charged with actual pseudo-formations or abnormal concretions, than with the serum of the blood; it is, therefore, more an alterative of sanguification, than a weakening agent, though, from the above cautions, you may infer that a certain amount of vital stamina is required for undergoing a regular course. But the alvine evacuations are not invariably increased; an opposite effect sometimes takes place, and then the Carlsbad salt is usually added. As regards the choice of the respective springs, you have not only to consider the various effects of heat, but also the difference of the quantity of carbonic acid. Its amount is smaller, and its intrinsic impregnation less adherent in proportion as the temperature is higher; whilst thus in the hotter, even during use, the solvent power exercised by heat naturally slackens with the decreasing temperature, and whilst the more rapid loss of carbonic acid causes the earthy bicarbonates to become sesquicarbonates, and more liable to precipitate, we have in the cooler a greater abundance and a more intimate adhesion of the carbonic acid, consequently a somewhat longer stability of the composition, the combinations of carbonic acid retaining, for a longer period, the character of bicarbonates, with less liability to deposition. If you wish, then, to produce a deeply penetrating action, and to excite the function of the skin and kidneys more particularly, you will give the hottest, the Sprudel (59° Reaumur). If you find a heightened alvine function to be the chief requisite, you will recommend the Mühlbrunnen ($44\frac{3}{4}$° Reaumur), or Theresienbrunnen (42° Reaumur); but if you merely desire an alterative action, a check of the abnormal mucosity and pinguefaction, and a remedy against vascular erethism, you will employ the coolest of the thermal springs, the Schlossbrunnen (temperature, 36° Reaumur).

A very frequent mode is to drink the cooler springs at first, and after some time to combine them with the hotter in this way:—Supposing the patient receives four to six glasses of Schlossbrunnen first, and increases the number; after some time he substitutes for the last glass of the cool spring one of a hotter spring, then for the last two, for the last three, and so on, till the cool spring is entirely superseded by the hotter one. Of course a great deal depends in this respect on the individual experience of the respective physicians, of whom there are not less than seventeen; at their head, the universally respected veteran of spa physicians, Dr. de Carro, besides Drs. Hochberger, Hlawacek, Fleckles, Forster, Preiss, Osterreicher, &c., all of whom may be consulted with perfect confidence by the invalids.

Though the chief efficacy be expected from the internal use of the springs, baths are also resorted to in the cooled mineral water. The vapour of the Hygiaeensquelle is collected for vapour baths. Douche baths, as well as clysters, are likewise employed in appropriate cases.

Not content with all the above media, peat soil is dug up at a distance of about two miles from Carlsbad, and mixed with Sprudel water for bathing, in cases of chronic rheumatism, anomalous gout, in chronic exanthemata, &c. It is also used as poultices in analogous local affections.

I have still to mention the Carlsbad salt, which is obtained by the natural evaporation of the Sprudel water, in vessels fixed to the bore-holes, whence formerly the water ran to waste into the Tepl river. The crystallised salt consists chiefly of sulphate of soda, with an inconsiderable admixture of carbonate of soda, and a minute quantity of lithia. Exposed to a strong heat, it immediately deliquesces. One ounce requires, to effect its solution, about double the quantity of cold, and nearly eleven drachms of hot water. The crystals of common Glauber salt are much firmer, and require longer time for deliquescence. 1700 pounds of the salt are annually obtained. It acts as a gentle and cooling purgative, without weakening or irritating the intestinal canal. Fr. Hoffman often prescribed it with *dec. tarax. or gramin.* in dyspepsia and flatulence; as a *diuretic* and lithontriptic with nitre; with bark and cascarilla *in ague.* Before beginning the course of the Carlsbad springs, a preparatory dose of one to two drachms of the salt is often administered for one or two days.

To prepare a salt, which should unite all the soluble ingredients of Carlsbad water, Dr. Hlawacek proceeded in the following manner:—He evaporated the obtained mother-lye without causing the sulphate of soda to separate in crystals; then he dissolved the dry mass in Schlossbrunnen water, filtered, and evaporated the solution. In the resulting *yellowish-white* powder, chloride of sodium and carbonate of soda maintain the same proportion as in the water itself. He considers it more powerful than the usual Carlsbad salt, and recommends it for exportation and employment with the Schlossbrunnen, especially in lithiasis. He also introduced '*Sprudel*' *soap.* Finding great advantage from the external application of common soda-soap, dissolved into a pappy consistence, in hepatic enlargements, he concluded that the solvent power of the water must be greatly assisted by a soap prepared with sprudel salt; and his expectations having been realized, he employs it in many instances with very satisfactory results. After the course of Carlsbad is completed, Teplitz is generally resorted to as an after-cure by persons of a gouty disposition, to obtain a gentle continuance of the same alkaline action, without the lowering and anti-plastic influence of the sulphates. The nervous power is thereby raised, without counteraction of the previous efficacy. More liberal diet is likewise permitted without injury, if used with reasonable care, and with gradually increased allowances. A very important warning to Continental patients is almost superfluous to the English, viz., to avoid drinking water or other cold beverages after taking fruit. This pernicious habit may not always engender the cholera, as it did on the occasion I mentioned in a former Lecture, but injurious it must be after such a strict diet, and such liquefying beverages, have considerably attenuated the organic power of resistance, at least for some time. And here I may state, by the bye, that the rational manner of English living is one of the greatest safeguards against epidemic diseases.

No wonder that life should be longer here than in many parts of the Continent, with a considerably greater freedom from avoidable diseases during the allotted period, and with comparatively greater physical resisting power, and other unmistakable signs of improved nutrition. As regards food, whilst in this island the most tender flesh from the best-fed domestic animals is simply exposed to the action of heat, just sufficient to increase its solubility in the gastric juice, in many parts of the Continent skilful cooks have to prepare savoury liquids out of the albuminous and gelatinous portions of the meat, and to season them in such various modes as to make a very agreeable impression on the palate. The warm liquid distending the stomach does not for the moment increase the tone of its muscular fibres. Nevertheless, the tougher and more fibrinous portion, the parent of the juicy soup, is now introduced, and forces the intestines to unwilling action. Some other dishes make their appearance, with the mere object of recalling the vanishing appetite, and of creating an artificial desire for a greater reception of food. And even now, when the more substantial dishes come before you in their various shapes, art must improve on nature and make them more palatable, by sauces and numerous intricate contrivances. However satisfactory all may appear while at table, still on rising, although you may have taken an inconsiderable sum total of really substantial nourishment, you feel overloaded, your movements are impeded, the physical oppression reacts on the mind, drowsiness, lassitude, and incapacity for exertion naturally ensue. An artificial stimulus, both for abdominal action and nervous power, is called into aid—viz., coffee.

Now, just imagine the consequences. Whilst the one satiated the want of nature, and supplied the organic waste by the simplest substitute, which had merely to be dissolved and reconstituted into its former atoms, to produce healthy chyle, the most appropriate for performing the nutrient function of the whole body, the other imposed five times the work on his teeth, on his salivary glands, and abdominal viscera, and when all is summed up, when the whole mass is sifted for contributing its share towards nutrition, the very purpose of the whole laborious task, why it is found that very little can be used for sanguification—at all events, less than from the former simple and short repast. Add to this increased work the proportionally advanced inability of performance, and you will not wonder at the thousands and thousands who suffer from piles, at the numerous atonic diseases of a vicious sanguification, at the frequently debilitated constitutions, and at the shortened period of existence, affecting so many individuals from avoidable causes. The injurious influence of excessive smoking on the composition and power of the mechanical masticators prevents the proper admixture of saliva, and the necessary comminution of the food, and thus heightens the evil.

But to return to Carlsbad: Franzensbad is used as an after-cure in hepatic derangements, when a combined action of sulphates with tonic remedies is to be continued for the completion of a commenced or progressing cure. A very remarkable instance came to my own notice. When visiting Franzensbad, I happened to be introduced to two Hungarian ladies (sisters, and both married), who came from a distance of 150 German miles (about 750 English), with the following complaint:—The younger sister, about thirty years of age, of a small and rather puny but otherwise healthy appearance, had suffered for two years with obstinate intermittent fever and induration of the liver. Large doses of quinine succeeded in relieving the fever, but only for a time, and she could always reckon on a return as soon as her menstruation appeared; then her sufferings in the right hypochondrium were very severe, and refused to yield to antiphlogistic and other remedies. The elder sister related to me that the sufferer's life had become a positive burden to her, all enjoyments being thwarted by these regularly recurring attacks. At last she was advised to resort to Carlsbad, which she used for five weeks. The induration of the liver diminished, but she felt still frequent pains in the right hypochondrium, and departed, very much debilitated, for Franzensbad. In the latter spa she had used peat-baths for one hour every evening, and drank the *Kalte Sprudel* during three weeks, and at the time I saw her she was completely cured, and about to rejoin her family. I was assured by the patient's sister that I should not know her, so much changed was her appearance. Whether the attacks subsequently returned or not I have no means of knowing, but certain it is, that the two sisters left Bohemia with the greatest happiness and gratitude for their restored health. The details of the previous suffering and misery were really so pitiable, that no one could help rejoicing at her recovery and improved mental condition. Wilful or involuntary deception is in this instance entirely out of the question, for they knew the purpose of my visit to be personal examination of the alleged efficacy of the springs, and therefore minutely communicated to me as exact a description of the former and present state of the health of the patient as possible. Besides, no very great amount of penetration is needed to recognise such an attempt, even if extending to exaggeration only. Perhaps you would prefer the report of her physician to her own account. But, Gentlemen, a chief reason why I think the mineral waters ought to form a distinct branch of medical education, though properly belonging to materia medica, is the circumstance that an exact knowledge of the specific efficacy, inertness or injury of the respective spas, cannot be obtained without personal examination of the patients. For I have already pointed out to you in a former Lecture, that the chemical constituents of the various springs afford in many instances no distinct, and in others only general indications. To recommend, therefore, this or that spa, with the positive assurance of having made a good selection, you must either undertake the above-mentioned examination of the different spas yourselves, or be taught by impartial medical observers, who have been enabled fully to accomplish their purpose by their knowledge of the language, manners, and customs of Continental inhabitants.—I confidently trust that you will not meet with that mishap not unfrequently occurring, viz., that patients are directed to certain spas with detailed reports by their medical advisers, and when examined by the spa physician, he occasionally finds that his spa is positively inappropriate, so that he is compelled to send the patient to another, or to persuade him to return home.

With what feelings of disappointment will such a patient meet us again; and still we cannot blame the foreign spa physician, who would have much preferred availing himself of our kind recommendation, and sending the patient back to his home cured or relieved.

Thus, persons with scirrhus or carcinoma uteri have been sent to Carlsbad, individuals with developed consumption and hectic fever to Ems; rheumatic patients with organic diseases of the heart to Wiesbaden; paralytics with distinct apoplectic tendency to Gastein, &c.

Such errors you will of course endeavour to avoid, by attending to the contra-indications enumerated with each spa, and especially by recommending those remedial springs whose curative agency admits of rational explanation. In instances such as are just referred to, reason must foretel aggravation of the evil.

LECTURE IX.

MARIENBAD—FRANZENSBAD.

GENTLEMEN,—From Carlsbad, at the right superior corner of the celebrated Bohemian triangle, we journey southward to its inferior corner, Marienbad. The diligence, which leaves the former at 4 P.M., performs the distance of twenty-five miles in six hours; from this tardiness you already perceive that the southern pikropega must be situated in a more elevated position; indeed, its altitude above the North Sea amounts to 1900 feet (800 feet higher than Carlsbad). Its latitude is below 50°; its eastern longitude, 12°. It belongs to the Pilsener Kreis (circle), which is chiefly spread over a mountain-plateau, at the foot of which the Tepl arises—a small river, which we have already noticed in its course from the south to the north, through Carlsbad, till it widens and falls into the Eger. Extremely numerous gas and mineral springs are locally connected with layers of peat along its course. Travellers, from Eger (twenty-four miles to the west) to Pilsen, in the south-east, have to pass the spa. You see the demesne of Tepl in a due easterly direction (nine miles distant), and Königswarth, in the north-west (six miles off). You can enter Marienbad, from the ravine-like opening, in the south only: pine and fir-covered mountains forming a towering enclosure from the other sides. In the east, the Hamelika rises and mingles with the peak of the Wahrhall; in the north, the Mühlberg and Steinhau, and in the west, the Schneiderhau. The Hamelika brook, rising at the western declivity of the mountain of the same name, is joined at the extremity of the valley by the Schneiderbach, to form the Auschowitzerbach. The spa is of comparatively recent origin, and the buildings are provided with many modern conveniences. An avenue of poplar trees leads from the Kreuzbrunnen (the chief spring) to the Carolinenbrunnen. In the heat of summer many visitors would probably prefer the shade of chestnut or lime-trees, but a greater regard to health was displayed by the selection of the present species, as the surrounding mountains deprive this spot of the morning and evening sun, and too much shade might, therefore, prove undesirable. From the Belvedere on the Steinhau, the prospect towards the west and south extends as far as the lofty Pfrienberg. Along the banks of the Auschowitzer brook you will find pleasant walks. If you proceed southward, through meadows and green fields, for about two miles, you will observe another spring bubbling up from the fertile ground, the Ferdinandsquelle. The vicarage of Pistan is visited by many, as, from its high position, it affords a magnificent view of the sombre Bohemian forest.

Among the places of resort near Marienbad, must be reckoned the Jägerhaus, on the Schneiderrang, near the zoological enclosure of Königswarth, where you can obtain a view of the Eger domains from the Luisenblick. The so-called "Judenkirchof," a curious assemblage of stones in an opening of the forest, the monument of Waldstein, and on the Mühlberg, the Friedrichstein, and Schweizergang are pointed out. On the Hamelika mountain the Pavilion may be visited, and at its declivity, the valley of the Ferdinandsbrunnen, and Böttiger's Ruhe (rest). This frequented spa, so crowded during the height of the season that many must content themselves with very meagre accommodation as regards residence—was a wilderness little more than fifty years ago, only provided with a half-ruined wooden hut, in which two iron caldrons were fixed for the preparation of Glauber's salt (sulphate of soda) out of the Kreuzbrunnen. A rough wooden enclosure of the spring was the only other work of human hands that could be perceived. Not even a footpath led to the spring, which had to be reached by stepping over stones irregularly laid across the numerous bogs and marshy spots. Notwithstanding this difficulty of access, numerous persons visited the spring in summer, and found relief from their ailments by the use of the water, leaving marks of the benefit obtained by writing with chalk, pencil, or charcoal, on the wooden boards their names and diseases, with the quantities of water drunk; sometimes even the number of the evacuations was noted down for the edification of the curious. Through the solicitations, and partly at the expense of the late Dr. Nehr, the bogs of the environs were drained, and the springs secured.

At the beginning of this century a road was constructed to the little chateau of Hammerhof (three miles distant). Stagnant waters were led off, hills were dug out, ditches filled up, walks laid out, and, the demand from the frequency of visitors rapidly increasing, new houses and fine buildings arose as promptly as such a limited locality would allow. Thus Dr. Nehr may be considered as the creator of Marienbad as a spa.

Its springs present greater variety than those of the therma we have just left. The foremost rank is occupied by the Kreuzbrunnen, bubbling up on the southern declivity of the steep Steinhau from half-efflorescent porphyreous granite. A magnificent colonnade marks its entrance. Only 141 cubic feet of water are furnished in twenty-four hours; but the supply increases in a direct proportion to the quantity of water drawn, more than 300,000 bottles being annually exported. The water is very sparkling, clear, inodorous, and transparent, but exposed to the atmosphere it soon becomes turbid. The taste is acidulous and saline, somewhat bitter; the temperature, 9½° Reaumur (53¼° Fahrenheit), specific gravity, 1·0094.

Its solid constituents amount to sixty-six grains in sixteen ounces (a scruple more than Carlsbad), viz.:—

38·11	grs. of	sulphate of soda (double the quantity in comparison with Carlsbad),
13·56	„	chloride of sodium (not quite double),
7·13	„	carbonate of soda,
3·93	„	carbonate of lime,
2·71	„	carbonate of magnesia,
0·17	„	carbonate of iron (only 1·100 of gr. in Carlsbad),
0·03	„	carbonate of manganese,
0·11	„	carbonate of lithia,
0·38	„	silex,

Carbonic acid gas, 8⅓ cubic inches.

Opposite the Kreuzbrunnen, at the southern end, is situated the *Carolinenbrunnen* (formerly called Neubrunnen), in the centre of an old grove of alder and fir-trees. The spring issues out of peat soil, and is covered by a temple, the cupola resting on eight Corinthian columns. Gas is constantly bubbling up from the opening. The water is sparkling and has an alkaline and ferruginous taste. Some *smell* of sulphuretted hydrogen is perceptible, but not demonstrable by analysis. Its carbonic acid being more firmly adherent, the oxide of iron remains for a longer period unprecipitated than is the case with the Kreuzbrunnen. Its solid ingredients are only 14¼ grains in sixteen ounces, being less than the fourth of the Kreuzbrunnen, viz.:—

2·79	grs. of	sulphate of soda,
0·82	,,	chloride of sodium,
0·20	,,	carbonate of soda,
3·66	,,	carbonate of lime,
3·94	,,	carbonate of magnesia,
0·44	,,	carbonate of iron (nearly three times as much as the Kreuzbrunnen),
0·46	,,	silica,
0·38	,,	extractive substance,

Carbonic acid, 15·43 cubic inches (nearly twice as much as Kreuzbrunnen),
Specific gravity, 1·0031.

The *Ambrosiusbrunnen* rises about seventy yards to the south of the Carolinenbrunnen, and has a more agreeable piquant taste. It contains only 10½ grains of solid constituents in sixteen ounces (the sixth of Kreuzbrunnen), viz.:—

1·86	grs. of	sulphate of soda,
1·64	,,	chloride of sodium,
1·66	,,	carbonate of soda,
2·89	,,	carbonate of lime,
2·72	,,	carbonate of magnesia,
0·34	,,	carbonate of iron (twice as much as Kreuzbrunnen, but less than Carolinenbrunnen),
0·48	,,	silica,

Carbonic acid, 12·9 cubic inches (less than Carolinenbrunnen),
Specific gravity, 1·0023.

About 100 steps from the Ambrosiusbrunnen, the *Marienbrunnen; or Badequelle,* arises in the peat-soil. The abundant evolution of carbonic acid gas keeps up a constant hissing sound. The layer of gas spread over the surface of the water is highest before sunrise, lowest at noon, and then increases again towards the evening. It expands in rainy weather, and decreases when the sky is serene. In a very humid state of the atmosphere, the gas reaches as far as the upper boarding ($5\frac{1}{2}$ feet above the level of the water). The carbonic acid is firmly adherent. It contains only $1\frac{3}{4}$ grains of solid constituents in sixteen ounces, viz., about 1-3rd of a grain of sulphate of soda, 1-25th chloride of sodium, nearly $\frac{1}{2}$ carbonate of lime, 3-100ths carbonate of iron, &c., and nine cubic inches of carbonic acid.

After the Kreuzbrunnen, Ferdinandsbrunnen, as already mentioned, claims the highest remedial powers. It arises at about a mile from Marienbad, in a meadow near the left bank of the Auschowitzerbach, and it appears that at some remote period attempts were made for extracting salt out of this spring. When dug up, granite nearly efflorescent was found to compose the bed of the water, whilst bubbles of carbonic acid gas continually issued in great abundance. The supply amounts to 2900 cubic feet in twenty-four hours. The water sparkles continually when drawn, and holds the carbonic acid so firmly, that even boiled water will redden litmus paper. Its taste is piquant, and rather saline; specific gravity 1·0046. Its solid ingredients amount to $45\frac{3}{4}$ grains in sixteen ounces (a scruple less than Kreuzbrunnen), viz.:—

22·53	grs. of	sulphate of soda	less than Kreuzbrunnen.
8·99	,,	chloride of sodium	
6·13	,,	carbonate of soda	
4·01	,,	carbonate of lime	more than Kreuzbrunnen.
3·04	,,	carbonate of magnesia	
0·39	,,	carbonate of iron	
0·09	,,	carbonate of manganese.	

Carbonate of lithia, 6-100ths.
0·66 silica.
Carbonic acid, $13\frac{3}{4}$ cubic inches (5 more than Kreuzbrunnen.)

Lastly, we have to visit the Waldquelle (forest spring), at the west of the Kreuzbrunnen, which contains 22 grains of solid ingredients in sixteen ounces (the third of Kreuzbrunnen), viz., 5¾ of sulphate of soda; two sulphate of potash (not possessed by another); 2¼ chloride of sodium; 6 carbonate of soda; 2¼ carbonate of lime; 2 9-10ths carbonate of magnesia; no iron; 1-10th carbonate of manganese; more than ½ a grain of silica, and 18¾ cubic inches of carbonic acid gas. It supplies 37 cubic feet of water in 24 hours.

The temperature of all the springs ranges between 7° and 9½° Reaumur (47° and 53° Fahrenheit). The Wiesenquelle, near the Ferdinandsbrunnen, is hardly ever employed. Another important healing agent is furnished by the layers of peat found at a great depth behind the bathing-house of the Marienbrunnen. It consists of a brown, bituminous, unctuous mass, intermixed with decomposed vegetable fibre. Sulphates of soda, of lime, and magnesia, with chloride of sodium, oxide of iron, silica, and sand, form its chief constituents. The peat is now also brought to the place from the Stänkerhau. After merely removing the grosser admixture of sand and small stones, it is used for mud-baths.

The abundance of the carbonic acid flowing out of the soil in these vast strata of peat, led to the construction of gas-baths, employed either for the whole body, where the patient sits dressed in the gas-basin, with only his head in the ordinary atmosphere—(the penetration of the gas to the epidermis is not obstructed in the slightest degree by the pervious clothes)—or streams of gas are applied locally by elastic tubes, communicating with the gas-reservoir, and held to the mouth, ears, eyes, or otherwise affected parts of the body. Ordinary baths of the heated mineral waters are likewise used. Douche and rain-baths are also well contrived and frequently employed.

Marienbad owes its virtues chiefly to the sulphate of soda, and is indicated in plethora, and for persons of luxurious habits. But why should simple purgatives not exercise similarly favourable results? For this reason: they certainly increase the peristaltic motion, and discharge offensive substances, but they also cause a greater quantity of serum to be excreted from the surface of the alimentary tube.

However useful and indispensable a purgative may prove in many instances, a course of purgatives would never be thought of as a remedy for producing beneficial alterative results. The case is quite different if we employ a remedy whose chief agent exerts a peculiar stimulating influence on the action of the liver, producing greenish, mucous, and fetid evacuations, with distinct evidence of a more than ordinary excretion of bilious matter, while copious serous purgation is avoided through the presence of silica and iron.

The lengthened contact of the dissolved ingredients with the intestinal fibres being thus effected, the subordinate quantity of chloride of sodium finds time to exert its beneficial action on the nutrient organs, whilst the carbonates of soda and of lime assist in preventing the formation of too abundant an acidity in the circulating fluid, and thus *improve* the renal and hepatic action, the latter having been merely increased by the Glauber-salt. Muscular exercise always attending the course of the water, a more active general circulation contributes likewise to counteract too great a stagnation of the portal circulation. Whilst Carlsbad acts, therefore, as a more powerful solvent, and as a more penetrating and lasting stimulant on the liver, skin, and kidneys, Marienbad is the more energetic and exclusive provocator of biliary excretion and of alvine secretions, and is applicable in cases of vascular erethism or local congestion, where the former would be fraught with danger.

From the above you will perceive that I strongly deprecate encouragement of excessive and continuous evacuations, and would advise discontinuance of the course, or decrease of the dose, if such should take place during the use of the water. On the other hand, non-increase of alvine action, or even obstruction, occasionally happening under the influence of Marienbad, should not be allowed to continue. Heating the water will increase its purgative action. Its employment in the form of clysters affords likewise powerful assistance. The separate springs exhibit different properties in relation to the difference of their composition. The Kreuzbrunnen stimulates to action all the abdominal organs, and therefore promotes the digestive function, and bilious excretion, whilst its carbonic acid increases the nervous tone. Dyspepsia and venous dyscrasia, with all their protean consequences, therefore, strongly indicate its employment; acidity, hypochondriasis, hysteria, enlargement of the liver, and morbid bilification, all belong to this category. The Ferdinandsbrunnen, with a smaller quantity of sulphate and other salts of soda, and with a greater proportion of lime, magnesia, silica, and iron, naturally acts as a less solvent remedy, and is more indicated when the tone of the secreting organs is to be roused from great torpor, and when the uropoietic system is chiefly to be acted upon. It forms, as it were, the transition from the highly solvent Kreuzbrunnen, to the purer tonic, the Carolinenbrunnen, which latter, by possessing nearly half a grain of iron in 16 ounces, with a very small quantity of solvent salts, displays its action more in the vascular system, increasing the tone and resisting power of the circulating fluid, and thus improving the general state of the nervous system; in fact, it is indicated where steel and other tonics are required. Ambrosiusquelle is somewhat inferior to the latter in effect, but quite analogous in its mode of action. The Marienquelle, with its abundance of gas, chiefly used for bathing, induces on entering the bath a sensation of chilliness, which soon gives way to increased heat and circulation over the whole epidermis, with subsequently improved nutrition. These baths are particularly useful in arthritic and rheumatico-paralytic affections, connected with hepatic and intestinal infarcta or torpor. The Waldquelle, the only spring which contains sulphate of potash, and no iron, with a very considerable amount of carbonic acid, is frequently drunk with warm milk or whey, in chronic pulmonary, and vesical catarrh, and in hysteric spasms and vomiting. The importance of potash and magnesia has been proved by the investigations of Liebig, who found that potash and chloride of potassium prevail in the liquid of the flesh, with magnesia as its predominant earth; whilst soda and chloride of sodium preponderate in the blood, with lime as the predominating earth. The gas and peat baths are powerful supporters of the curative action of the springs, but they also exercise independent properties of their own, belonging to the inherent stimulus of carbonic acid on the peripheric nervous system, and of the peat on the plastic and glandular organs. The gas contains in 1000 volumes, 74 of nitrogen, and 26 of oxygen, the rest is carbonic acid; its temperature is rather lower than that of the atmosphere. The incident which led to the separate employment of the gas-baths is too remarkable to be omitted. The same *Dr. Struve*, whom I mentioned in my first lecture, as the most successful imitator of the natural springs, and as the originator of the so-called Brighton pump-room, experienced the result of the first trial in his own person. For many years his left leg was frequently the seat of violent pains, along the course of the ischiatic nerve, from the hip-joint downwards. The chief cause was congelation of such intensity, that the limb was only preserved with difficulty; he also partly ascribed the evil to the inhalation of hydrocyanic acid, during his chemical operations, which so often induces paralysis of the lower extremities. Torpidity of the lymphatic system was connected with these sufferings. The whole leg, particularly the tibial part, was covered with numerous hardened glands. The lymphatic vessels had the appearance of distended blood-vessels. Nutrition was also considerably impaired, the left leg being more than half an inch thinner than the right one. Every little exertion increased the pains, and could not be performed without exhaustion. At last he could not walk without a stick, and often required the arm of another person to support him. The portal system was likewise affected. A considerable swelling of the liver had been happily cured the year before (1817), but the left hepatic lobe was still distended. Under these circumstances, he put his trust in the solvent constituents of the Kreuzbrunnen, on the animating power of the Marienbath, and on fomentations with warmed peat. For ten days he had used these three remedial means without perceptible relief. He therefore resolved on making the first trial with the gas-bath. With difficulty and pain, and with the support of his servant, he was conducted over the small hills and declivities to the Marienbrunnen. The suffering leg, denuded only of the boot, was now exposed to the effervescing gas, covering the surface of the water. The introduction of a light indicated the exact height of the gas-layer, and its line of demarcation, by its extinction. The first sensation was that of chill. Soon, however, an agreeable warmth took its place, with a peculiar sensation, as of ants creeping along the larger nervous ramifications, somewhat analogous to the beginning action of a mustard-poultice. After thirty minutes he withdrew the leg and supported it with a bandage. He began the way back with his habitual precaution, and trust to support. 'But,' he says, 'who could picture the intense joy and gratitude that overpowered me when I discovered, by every new step, that power had returned to the weakened leg, and that the uninterrupted gnawing pain had left it! With agility I walked unassisted over spaces which would have been a work of impossibility an hour ago.' But these blessings of an experimental attempt were not transitory; they still continued for a fortnight after the first trial. The daily repetition of the gas-bath produced invariably the sensations described. Dr. Struve continued these baths for three weeks longer, in conjunction with the internal use of the Kreuzbrunnen and the local application of moor-earth. He then left the spa completely cured. Ever since, the gas-baths have been frequently employed. During the use of the mud-baths, Dr. Wetzler observed the skin to become momentarily contracted, and its susceptibility blunted. He had himself suffered from a disagreeable and sometimes painful sensation of the thighs, of rheumatic origin. Neither saline nor steel-baths could relieve the evil, which yielded after the first mud-bath. They are particularly recommended in erethic atony of the epidermis, in tendency to profuse perspiration, great susceptibility towards atmospheric changes, &c. Marienbad is INAPPLICABLE in real digestive weakness, in general atony, whether resulting from loss of blood or from exhausting diseases; in cerebral congestion, internal suppuration, hectic fever, inflammation of internal organs, carcinoma, atonic ulcers, scorbutic dyscrasia, &c. Carlsbad offers such important points of analogy and difference, that it becomes necessary to carefully discriminate between the two, in many given cases which apparently belong to the sphere of action of both. First, we have to take the difference of temperature into consideration. The high temperature of Carlsbad at once excludes all patients of plethoric tendency, with vascular erethism, that may be benefited by the colder springs of Marienbad. Next we have to consider the presence of a larger quantity of iron in the latter as a greater promoter of sanguineous plasticity and reproduction. The larger amount of liquefying sulphate of soda (nearly twice as much) renders Marienbad applicable in cases of abdominal plethora, with a sanguineous constitution, where we should have to avoid Carlsbad. On the other hand, the greater proportion of carbonate of soda and of lime, gives the latter more power in renal diseases, as lithiasis, &c., whilst its heat assists the action on the cutaneous system, counteracts disorders resulting from repelled exanthemata, from rheumatic and arthritic causes. Carlsbad being invariably useful whenever improved nutrition and circulation of the sero-fibrous or portal system are especially indicated, it stands unequalled in inveterate hepatic induration, gallstones, &c.; in fact, when a more thoroughly penetrating action is desired. But when abdominal secretion and excretion have to be *chiefly* promoted, when hepatic and alvine torpor have to be roused, Marienbad will find its appropriate employment; though we are unable to determine whether its remarkable efficacy be due to a mere mechanical increase of peristaltic motion, or whether the sulphates, particularly of soda, tend to decarbonise the blood by yielding oxygen to its carbon for the formation of carbonic acid on the one hand, whereby the blood becomes partially arterialised, and its circulating force stimulated, whilst sulphuretted hydrogen may be produced on the other, and exert a beneficial action on the ganglionic nervous plexus. For if, under the influence of vital heat, soda and sulphuric acid allow part of their oxygen to become absorbed by the carbon, we may expect that the newly-produced carbonic acid strives to enter into combination with part of the free sodium. This latter must therefore decompose the water of the gastric juice, and, attracting its oxygen to become carbonate of soda, it encourages the hydrogen to enter into combination with the portion of the deoxidised sulphur, and thus free sulphuretted hydrogen would be accounted for. If we do not generally observe the peculiar effects of sulphuretted hydrogen by the ordinary administration of sulphate of soda as a purgative, this is easily explained by rapid elimination of the remedy with the fæcal impurities. But when a more lengthened contact with the gastric contents affords a greater opportunity for development of chemical attraction, and for interchange of substances according to stronger affinities, with chemico-vital modifications, such a result is highly probable.

You will remember, Gentlemen, the cases of impetigo I mentioned, which were completely cured in the German Hospital, under the influence of sulphate of soda, without purgation; and really it would be quite impossible, in my opinion, to account otherwise for the beneficial effects of this remedy, which did not produce in the instances I have mentioned the slightest physical change in the patients, with the exception of the gradually vanishing eruption. The peculiar acrimonious substance, mingled with the organic fluids, and deposited by the *vis medicatrix naturæ* on the epidermis, may be catalytically removed from the system by the sulphuretted hydrogen. The increased proportion of soda in the blood must also promote its liquidity and moving power, whereby renewal of the offensive animal substance may, in some measure, be prevented.

Carlsbad containing nearly 2-100ths of a grain of iodine (0·017) owes part of its solvent power to this ingredient; for scrofulous complications do not contra-indicate its use, but, on the contrary, they are frequently combated by the

Spa. To sum up, you have to select Carlsbad, when the general vitality has to be roused, in persons not devoid of a certain amount of organic materials, which, however, are not properly brought into their required function; whilst you have to give the preference to Marienbad, when general irritability and exercise of abnormal power has to be allayed, by concentrating a greater focus of action in the abdominal organs. In combating the alvine hyperæmic condition, you will cause the systemic orgasm to be diminished, and the concord between the sensitive and irritable organic sphere to be restored. Hofrath, Dr. Heidler, Drs. Danzer, Frankl, Herzig, and Kratzmann, are the physicians of Marienbad. Their writings greatly contributed to spread the fame of the Spa.

Franzensbad.—Starting from Marienbad, at two A.M., the diligence arrives after four hours at Franzensbad, latitude above 50°, longitude 12°, which you see situated on the north-west, at a distance of twenty miles, 1500 feet above the level of the sea. The most remarkable place you pass, on your road, is the town of Eger, on the right bank of the Eger river, one league to the south of the Spa. The whole district is called the Egerland, forming the north-western part of Bohemia, near the Bavarian and Saxon boundary. In the town-house of Eger, which is replete with antiquarian curiosities, the halberd is shown, with which the celebrated Wallenstein was pierced, in 1634, and whose fate forms the subject of the beautiful drama by the immortal Schiller. In speaking of these regions, Goethe says:—" If Bohemia be considered as a large valley, relieved of its waters at Aussig, on the Elbe, the district of Eger may be imagined as a smaller one, which discharges its waters into the river of its own name." This spot is impacted as it were in an obtuse mountainous angle, the Fichtelgebirg forming the corner, with the Erzgebirg as its superior, and the Bohemian Forest as its inferior branch. Baireuth lies forty miles distant to the west; Hof, thirty to the north-west; and Carlsbad, the same distance to the north-east. The encircling mountains consist of primary rocks, with the exception of the easterly

Kulmerberg, which is composed of sandstone and slate clay. The plain exhibits the character of alluvial land. If you wish to remember the respective position and altitude of the important Bohemian triangle, you have merely to seek the origin of the Eger river (at the foot of the Schneeberg, the highest peak of the Fichtel-mountains, below 50° latitude), and to pursue its easterly course. Having passed the town of Eger, it bends slightly northwards. After having performed about the third of its journey, it is seen moving forward a short distance above Carlsbad. Thus the latter spa must have a less height than Franzensbad, from which the river requires a gradual declivity for facilitating its course. The difference of altitude amounts to 400 feet. As regards Marienbad, a similar relation takes place. The same river Tepl originates in its neighbourhood, which approaches its termination at Carlsbad. The altitude of Marienbad must, therefore, be more considerable, and being amongst the three nearest the mountainous south, it exceeds its western angle by 400, and its northern by 800 feet. The Eger, which we have left near Carlsbad, proceeds towards the north-east, leaving Püllna and Seidlitz in the north, and Saidschutz in the south. Above Seidlitz you perceive Bilin, and above this, the most northern, Teplitz, which enjoys rather more than half the altitude of Carlsbad, being situated near the termination of the Erz mountain branch, that commenced at Franzensbad. Afterwards the Eger falls into the Elbe, near Leitmeritz, between Dresden in the north and Prague in the south. In order to become perfectly familiarized with these topographical details, I would advise you to draw a line from west to east, representing the Eger, then another from south to north, taking the indicated position of the Tepl; and lastly, a line marking the natural eastern boundary of these Bohemian spas, from Dresden to Prague. By putting, then, the names of the various spas in their described positions, an apparently labyrinthine crowd of highly important mineral springs, compressed into such a small compass, will become perfectly clear and distinct. As early as the seventeenth century, the town of

Eger was visited by very high personages, on account of the neighbouring mineral sources. From Eger, a very cheerful road, bordered with umbrageous trees, leads, after passing the village of Schlada, to the colony of Franzensbad. Passing through a very tastefully laid out park-like walk, you perceive the Franzensquelle at your left, with its temple-shaped inclosure, and the contiguous colonnade and Curhaus. On the right the Salzquelle (salt-spring) meets your eye, the newly-built packing-house, and the pavilion, with the gas-baths. You are now in the so-called Kaiserstrasse, adorned on both sides with chesnut trees, and containing the best habitations of the place. A small park forms the end of the street. The Kammerbühl mountain, a short distance from Eger, with the characteristics of a former volcano, will afford the visitors a beautiful perspective of the environs. Walks to the neighbouring villages of Unter and Oberlohna, Oberndorf, Langenbrunk, &c., furnish ample opportunities for pedestrian exercise.

The most renowned of the springs, the *Franzensbrunnen*, yields 275 cubic inches of water per minute. Its temperature is $9\frac{1}{3}$° Reaumur ($52\frac{1}{4}$° Fahrenheit), its specific gravity 1·0058. Small gas bubbles constantly rise, and cause an undulating motion of the water, which is clear and transparent, even for a long time after exposure to the atmosphere.

This spring shows a very intrinsic combination of its constituents. It possesses a refreshing, piquant, and acidulous taste, with some after taste of iron. The surface of the water is constantly covered with a considerable layer of carbonic acid gas. The brunnen contains 42 1-5th gr. of solid ingredients in 16 ounces (thus one scruple less than Kreuzbrunnen of Marienbad), viz.—

24·50	grs. of	sulphate of soda (14 gr. less than Marienbad),
9·23	,,	chloride of sodium (4 gr. less),
5·18	,,	carbonate of soda (2 gr. less),
0·67	,,	carbonate of magnesia (2 gr. less),
1·80	,,	carbonate of lime (2 gr. less),
0·23	,,	carbonate of iron ($\frac{1}{4}$ of a gr. 6-100 more),
0·47	,,	silex (one-tenth more.)

Besides 2-100 phosphate of lime, 1-100 phosphate of alumina, 3-100 carbonate of lithia, 4-100 carbonate of manganese, 3-1000 carbonate of strontia; 40 cubic inches of carbonic acid (five times as much as Kreuzbrunnen), with a distinctly perceptible odour of sulphuretted hydrogen gas. The *Louisenquelle* arises in a north-westerly direction from the latter, in a peat meadow, and is, properly speaking, a combination of several confluent springs. It has less depth than the Franzensquelle; its temperature is $9\frac{3}{4}$° Reaumur; its specific gravity 1·0057. Constant motion from the turbulent gas bubbles is likewise observed here. The water appears rather more turbid in the basin: but when drawn, it is clear, transparent, and sparkling. Exposed to the atmosphere, it resists decomposition even a longer period than the above-mentioned spring. Its chief employment being external, for common baths and mud-baths, I shall content myself with stating as regards its analysis, that it contains 7 grains less in 16 ounces than the Franzensbrunnen (viz. $35\frac{3}{4}$), the various ingredients observing analogous proportions, with the only exception of iron, which it possesses to a greater amount (0·23). Its carbonic acid is likewise less by 8 cubic inches (viz. 32). A few steps to the north of the Louisenquelle will bring you to the "*Kalte Sprudel*" (cold bubbler), so called in contradistinction to the hot Sprudel of Carlsbad, whose heat occupies three-fourths of the thermometric range between the ordinary freezing and boiling points. The constant evolution of gas causes such a violent hissing sound, that it has been invested with the name of Sprudel, rather inappropriately, in my opinion, for a distinct rising and falling of the water column cannot be observed. When drawn, the water is perfectly clear and transparent, and able to resist for a long period the decomposing influence of the atmosphere. It exhibits a pricking acidulous taste, with a saltish after taste —odour of sulphuretted hydrogen is strongly marked. The layer of gas covering the surface of the water sometimes reaches to the height of several feet. This spring is both used for drinking and bathing. It contains $44\frac{1}{2}$ grains of solid ingredients in 16 ounces; thus, two more than the

Franzensquelle. It possesses 2 gr. more of sulphate of soda, ½ a gr. less of chloride of sodium, 2 gr. more of carbonate of soda, 3-100 less of iron, and 1 cubic inch less of carbonic acid; in all other respects the two are similarly constituted.

The *Salzquelle* (salt spring), to the east of Franzensbrunnen, exhibits a gently alkaline taste, without any astringency. It contains 4 grs. less of solid ingredients than the Franzensquelle (38¼ grs.), 3 less of sulphate of soda, ½ gr. less of chloride of sodium, 2 less of carbonate of soda, rather less carbonate of lime, and only 7-100 of carb. of iron; carbonic acid only 26¾ cubic inches (14 cubic inches less). The *Wiesenquelle*, to the south-east of the Salzquelle contains 46¼ gr. of solid ingredients in 16 ounces (but only 4-100 of iron). The *Gasquelle* (gas source), formerly known under the denomination of *Polterbrunnen,* evolves pure carbonic acid gas in great abundance, with one per cent. of hydrothionic acid, and is employed for douches, local, and general baths. The strata of peat occupy a great extent round Franzensbad. Within the peat-soil, blackish-brown mud is found impacted in the neighbourhood of the springs, of a fine, soft, and unctuous consistence. If moistened, it spreads a sulphurous odour. The peat is carefully cleaned through a sieve, and then mixed with the water of the Luisenquelle, either for local application or for general baths.*

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* 1000 parts of dried peat contain 112 parts soluble in water, viz., sulphate of soda 38, of magnesia ½, of lime 4¾, of strontia 1-10, of alumina 4¾, of iron 24¾, of manganese 8-100, chloride of sodium 10, silex 1¼, (soluble through combination with humic acid, or merely present in the solution as a mechanical admixture,) gummous substance 2-10, humic acid, extractive substance 20, tannin, fixed hydrate water 4; 37 parts soluble in alcohol, viz., resinous ulmine or humus; 252 parts, (in combination with humic acid,) soluble in muriatic acid, magnesia 14, sulphate of lime 10¾, phosphate of lime 3½, alumina 29½, proto-carbonate of iron 88½, protoxide of manganese ½, silica with carbon 42¾, and vegetable substances 26; 123 parts soluble in ammonia, viz., ulmine or humic acid; and lastly, the rest insoluble—viz., gross sand 50¼, and undecomposed vegetable substances 423.

You find in the springs nearly the same constituents as in Kreuzbrunnen of Marienbad; but the inferior amount of Glaubersalt induces a less lowering and antiplastic action; the diminished proportion of chloride of sodium a less solvent power; whilst its greater proportion of iron, silica, and carbonic acid, stamps it as a highly valuable, gently-stimulating tonic, displaying its chief sphere of action on the ganglionic nervous system. The happy combination of ingredients promises us increased alvine peristaltic motion, improved biliary and renal excretion, restoration of stagnant or otherwise abnormal portal circulation, without the weakening and exhausting secondary results we might have to fear in some instances, from the fully-developed effects of an energetic course of the sulphates of Marienbad, or of the thermal watery impregnations of Carlsbad. On the other hand, we must consider that the very large amount of carbonic acid which accompanies the curative ingredients here, imparts to them a more dynamic effect, relying for the production of the critical changes more on the roused vital forces, than on the chemical changes resulting from the penetration of the more highly charged Marienbad, or the heated and more violently acting Carlsbad-water. This must not be considered as depreciating the two latter. On the contrary, the exact knowledge of the primary and secondary effects of each, will enable us better to select in various morbid modifications. Franzensbad acts specifically in similar diseases as Marienbad; the whole distinction merely refers to the individuality of the respective patients. If, for instance, you have a torpid, bloated up, icteric European, who has been subjected to lengthened attacks of intermittent fever, in a tropical climate, and now remains tormented by hepatic or splenetic physconia, with all signs of abdominal inaction, and without decided inflammatory or congestive symptoms, Carlsbad is alone able to bring about a happy result. But suppose a florid muscular person, of middle age, suffers from indigestion, hepatic engorgement, inaction of the bowels, hæmorrhoidal congestion, or from any of the numerous evils due to luxurious and sedentary living without corresponding muscular exercise; Marienbad will be unsurpassed by any other spa. A third individual presents himself to you, with similar hypochondriacal derangement, but he neither suffers from sequelæ of intermittent fever, nor does he seem to possess a large amount of organic materials of resistance; he probably owes his intestinal derangement to an excessive pursuit of study or business, or to overburdening mental depression; his temper is irritable, his cares and fears constantly surround him, he feels often chilly, particularly at his hands and feet, want of animation being stamped on his whole appearance; for him you have to choose Franzensbad as the most appropriate spring. Of course the many varieties of adjuvants in the three spas, must not be left out of our consideration, but the respective chief efficacy of each will be most strikingly unfolded in the described individualities. Franzensbrunnen has the special property of improving digestion, and increasing the appetite in a high degree. Acidity, mucosity, and biliary obstruction are powerfully counteracted, arterial circulation is heightened, hæmorrhoidal and menstrual flux are promoted if deficient, atony of the nervous system is raised; blennorrhages of the rectum, bladder, and vagina, likewise frequently yield to the water. Pale, cachectic, and exsanguine individuals feel particularly great benefit. Uterine debility, functional anomalies, as dysmenorrhœa, sterility, inclination to abortion, are often cured here. The spa is frequently employed after very solvent and weakening courses, as an after-cure, with great benefit. In fact, it holds a high and undisputed rank in such diseases and conditions in which a pure chalybeate would be indicated, if abdominal venosity and hyperæmia did not require a special remedial complex action. The spa is injurious in plethora, inflammatory diathesis, or inflammation of internal organs, congestion to the brain or other vital viscera, diseases of the heart, induration or suppuration of internal organs; generally speaking, excitable, sanguineous, and erethic constitutions, are less benefited here, than the chlorotic, lax, phlegmatic, and torpid.

The Salzquelle varies in some respects from the Franzensbrunnen, being less stimulating (through the smaller proportion of iron). Its action on the urinary secretion and excretion, is particularly marked; it greatly diminishes increased systemic sensibility and irritability. The Kalte Sprudel, containing more sulphate and carbonate of soda than the above springs, excels in the promotion of all abdominal secretions and excretions, and ought to be employed in preference whenever a more penetrating and solvent action is required; but no vascular orgasm must be present. In many instances, before drinking, a part of the carbonic acid is allowed to diffuse itself, so as not to cause too powerful a stimulation. If the spa be employed as an after-cure, the Salzquelle, as the least exciting, is used first, then succeeded by the Kalte Sprudel, and the course closed with the Franzensquelle. The internal use of the water is powerfully assisted by the baths. The great utility of the gas and peat in many forms of local and general application, has already been mentioned. The constitution of the latter informs you of its highly solvent and tonic properties, wherein it excels that of Marienbad. The sensation caused by a peat-bath is, in my opinion, the most pleasurable that can possibly be excited by any bath. The warm, unctuous, elastic medium gives support, and yields at the same time to our moving limbs. However forbidding the black broth may look, if you are once seated in the baignoire, the agreeably titillating effect exercised by the semi-liquid mass on the peripheric ends of the nerves is extremely agreeable, and you leave it with regret, abridging the luxurious immersion by being warned of the danger connected with a too great prolongation. The stay is gradually increased from a quarter of an hour to an hour. A warm-water bath stands near the other in the same room, and serves to relieve you of the adherent black mass. If you inspect yourselves in the looking-glass after leaving the peat bath, you may well be frightened by the altered being you behold. After immersion in the waterbath, you observe the skin to have become wrinkled and loosened, as it were, just as if it had become too wide a covering for the body. Increase of appetite may be reckoned upon as an invariable follower of the moor-bath. How useful these baths must prove in excessive perspiration through cutaneous atony, in repelled eruptions, in arthritic and rheumatic disorders, &c., is too obvious to require further allusion. After Carlsbad, Franzensbrunnen has been used for many years. The curative process instituted at the former is here energetically continued. The atony of some assimilative organ, produced by the long use of the hot Carlsbad-water, is raised on the one hand, whilst, on the other hand, the medical effect of analogous ingredients is proceeded with. It is desirable, even in cases of completed cure, at least after very inveterate and chronic diseases, that the patient should not expose himself to all his former injurious influences by an immediate return home, but that he should rather pass some weeks at Franzensbad, strengthening his health, to guard it against possible relapse. Though the intrinsic adherence of carbonic acid peculiarly fits the Franzensbad springs for exportation (which annually increases all over the continent), they are but rarely to be met with in this country, whilst many indications must be furnished for their employment. The imported water acts more as a solvent (by the partial precipitation of iron) than as a tonic, and is, therefore, very useful in abdominal infarcta and portal obstruction. Where circumstances prevent patients from visiting Franzensbad as an after-cure, they might, with great advantage, drink the water at their homes, either pure, or with wine and sugar, according to the required efficacy. Hufeland speaks of Frederick the Great having been freed from a dangerous disease by the use of the Eger water (the former name of Franzensbrunnen), which he then continued annually for the preservation of his health. In 1822, this physician says, in his 'Journal of Practical Medicine'—'Men of business or learning, who had been fixed to the writing-table the whole year, and had contracted dyspepsia, abdominal obstruction, hæmorrhoidal or arthritic tendency, were formerly in the habit, here in Berlin, of using the Franzensbrunnen for four weeks, with a great deal of exercise in the open air, and relaxation from the usual mental exertion. By this annual course they freed themselves from the accumulated morbific matter, and became strengthened for the next year's labours. Thus, notwithstanding injurious influences, many were able to preserve their health to a very great age, and prevent the development of various diseases, by which they might otherwise have been afflicted.' Drs. Cartellieri, Koestler, Palliardi, Boschan, Sommer, Komma, &c., are the physicians of Franzensbad.

The important class of pikropegæ terminates with this mineral spring, and at our next meeting I shall have to accompany you to the well-known beautiful Bavarian spa of Kissingen, which may be considered as the sovereign representative of the highly valuable saline springs next claiming our notice.

LECTURE X.

KISSINGEN.—BOCKLET.

GENTLEMEN,—The springs now coming under our consideration are called *Halopegæ*, saline springs (from ἅλς, salt, and πηγὴ, spring). They generally arise from secondary strata, either from rocksalt, through which they pass, or from the salt strata of the zechstone of gypsum or variegated sandstone; or, if of alkaline character, out of corresponding volcanic formations, as basaltes, lava containing fluor-spar, &c. Their taste varies according to the secondary constituents present, being either saltish or bitterish, astringent, alkaline, or ferruginous. Combinations of chlorine with sodium, magnesium, or calcium, form the chief ingredients. In some, no perceptible quantity of gas is discovered; in others, carbonic acid, nitrogen, carburetted hydrogen, or common air, is found to be admixed; rarely sulphuretted hydrogen. If hot, they are named *halothermæ* (from ἅλς, salt, and θερμὸς, hot). Possessing a smaller quantity of saline ingredients (though these are more thoroughly amalgamated), they have a less saline taste and odour, rather resembling weak chicken-broth, somewhat oversalted. The cold saline springs, *Halokrenæ* (from ἅλς, salt, and κρήνη, cold spring), often acquire a piquant and refreshing taste, and a sparkling appearance, from the great quantity of carbonic acid present, which exhibits an action analogous to that of heat in the complete solution and unity of the ingredients. *Salt-springs* and *Salt-lixivia* (*Soolen, Salzlaugen*) do not originally belong to the mineral springs, but from their medicinal use we should not omit to mention them in this place. Vetter terms them Halmyrides (from ἅλς, salt, and μυρὶς, an ointment pot). They are more often the products of evaporated saline springs than natural sources. Their specific gravity generally exceeds 1·050; their temperature is low, their taste too nauseous and acrid to be used for drinking or bathing without dilution with another less impregnated water. Their constituents differ from those of the Halopegæ merely in quantity. Minute proportions of *iodine* and *bromine* are contained in nearly all spas of this class. These important ingredients assume a predominant rank in some, and stamp them with the name and character of *Iodepegæ* (Iodine springs). We ought perhaps not to pass over the representative of all saline waters—viz., the mighty ocean, with its green colour, its disagreeably bitter and saltish taste, its peculiar aromatic odour, and its specific gravity, ranging between 1·026 and 1·029; with a more constant and moderate temperature than that of the air, and with a quantity of solid ingredients, amounting to 330 grains in some instances, and in others to less than half that quantity. Inland seas have a diminished amount of solid ingredients, and a correspondingly lower specific gravity. Besides the chlorides of sodium, magnesium, and calcium, invariably present, we meet with sulphates of these bases, some iodine or bromine, and organic matter.

The springs of this class widely differ in their medicinal qualities from the former. They chiefly act on the mucous membranes, which they stimulate to greater activity. The influence of chloride of sodium on the alimentary canal has been too often alluded to already, to require further remark here. Its presence in the saliva shows that it is necessary for the proper performance of the digestive function; its chlorine maintaining the acidity of the gastric juice by the formation of hydrochloric acid with the hydrogen of the liquid, whilst the disengaged sodium appropriates to itself the other element of water (oxygen), and exerts, as soda, a liquefying power on albuminous productions, preparing them for assimilation or elimination. Soda being the chief alkali of serum, the fluidity of the blood circulating in the abdominal vessels becomes promoted by the use of these saline waters, and thus stagnations and obstructions in the portal system are removed. Reflux of venous blood towards the central organ of circulation being facilitated, the arterial movements must become proportionally invigorated, and thus we see organic reproduction considerably improved under their influence. Persons of weakly or irritable constitutions, inclined to disorders of the lymphatic or serofibrous systems, are particularly benefited by them. The laxity of fibre and the torpor of nerve, produced by weakening diseases or exhausting excesses, likewise claim the powerful aid of the Halopegæ. The chloride of calcium and magnesium, though only present in a subordinate quantity, exercise a peculiar alterative action on the composition of the organic solids. They will not increase mucous secretion or peristaltic motion, if at all prominent, but rather overstimulate, with retardation of alvine excretions after some time. This will furnish a useful indication whenever the abdominal excretions are carried to excess, and of course a counter-indication in the opposite case. The additional presence of carbonates of alkalies will check any excessive formation of acidity, beneficially influencing renal and biliary secretion, and thus helping to remove impediments to normal chylification and nutrition.

I now intend, gentlemen, to leave Bohemia, with its triangular plains, and encircling hills, and to seek the kingdom of Bavaria. Leaving Franzensbad at 7 P.M. for the north-westerly town of *Hof*, you may not arrive before three o'clock the next morning, consuming eight hours in travelling a distance of about thirty miles. This is partly due to the badness of the road, and partly to a considerable delay on the frontier between Austria and Bavaria. Passports, luggage, &c., are all most minutely searched and examined. The paper-money on which you have now been wont to live for some time, is refused with scorn. Metallic coin makes its appearance again, to your relief, unless you possess a pocket-book full of now almost worthless paper. From *Hof* the train starts at 5 A.M., and carries you rapidly enough to *Bamberg* on the Maine (in the south-west).

The diligence awaits you here, and brings you in about eight hours through Schweinfurt, in a constant north-westerly direction to the little town of *Kissingen.*

Kissingen, on the Fränkishe Saale,* stands 600 feet above the level of the sea (100 above the surface of the Maine at Würzburg), lat. 50°, east long. 10°, in a fertile and charming valley, encircled by orchards and mountains. Würzburg is twelve leagues distant to the south, and Brückenau six to the north. The course of the river indicates the direction of the valley from north to south. The surrounding mountains consist of stratified lime and sandstone, joining in the north the stratified Trapp and basalt mountains of the Rhön. The extensive salt and graduation works are reached by a pleasant walk of about a mile to the north of the town. Somewhat farther in the north the elevated *Kreuzberg,* with its towering peak, closes the valley.

Towards the south, the valley is terminated by the Scheinberg, which is clothed with rich vineyards on its southern declivity. In the north-west rises the *Staffelberg,* the highest of the encircling mountains, covered to its very summit with the vine and ancient oaks. From the ruins of the citadel of *Bodenlaube*, on the Steigberg mountain opposite, you have a very interesting view of many castles and picturesque spots of the environs. Towards the east the valley is widened by the flattening of the mountains. A green vale stretches itself hence for about a mile and a half, having a forest of fir-trees rising upon the mountain ridge on the right, and the vine-clad Sinnberg on the left, as far as Winkels, a pretty village studded with fruit-trees, and bordered by hills clothed again with high firs, rising above the vineyards. Thus you look upon a fine landscape, where oak and fir covered mountains alternate with meadow-plains, vineyards, and abundant orchards, intersected by the serpentine course of the river Saale. The salt works claim great antiquity. Tacitus is quoted as having made the following allusion to the saline character of the place:—'In the same summer the Hermunduri and Catti fought a great battle, each wishing to obtain by force a frontier river blessed by the production of salt. Besides the habit of settling all disputes by arms, they were actuated by the religious belief that this region was particularly near heaven, and that the prayers of mortals were nowhere nearer fulfilment.'

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* The Saale rises in the north between the Werra on the right, and the Rhöngebirge on the left, it then meanders through Bocklet, bends slightly to the south-west to run through Kissingen, and lastly pursues this direction till it joins the river Maine, near Gemünden.

The springs are situated to the south of the town, on the left bank of the Saale. The '*Max*,' or '*Sauerbrunnen*,' lies opposite the 'Kurhaus,' in an oval deepening of the 'Kurgarten,' to which we have to descend a few steps. This spring issues out of fissures in sandstone rock, with a temperature of 8¾° R. = 52° F. The water is as clear as crystal, with an agreeably acidulous pungent taste. Numerous air-bubbles constantly rise and burst on the surface, with a hissing noise. The water is found to contain 30½ grains of solid ingredients in 16 ounces, and 31 cubic inches of carbonic acid gas, but no iron. The *Ragozi*, or Kurbrunnen, the most renowned of the springs, rises nearest the Saale, to the south of the Maxbrunnen, in a recess surrounded by stone balustrades, and accessible by steps from four sides. It does not issue from sandstone rock, like the former, but from layers of basalt and sandstone, with a temperature of 9° R. = 52¼° F. The hissing noise occasioned by the rising and bursting gas-bubbles, may be heard at a distance. The water is clear and sparkling; the taste saline, bitterish, and slightly astringent. It is only used for drinking. It contains no less than 85½ grains of solid ingredients in 16 ounces; and in this respect surpasses all the springs we have yet had under our consideration (with exception of the bitter waters). Chloride of sodium forms three-fourths of these ingredients, which contain besides more than half a grain of bromide of magnesium (7-10ths) and of carbonate of iron (6-10ths), with twenty-six cubic inches of carbonic acid gas. The curious name of Ragoczy is said to be derived from that of a Croatian officer who first drank from this healing water, which was discovered in 1738, in the dry bed of the Saale, upon the river being diverted from the 'Kurhaus.'

Its neighbour, *Pandur*, or Badebrunnen (bathing spring), received its name, according to the same authority, from a more humble origin—viz., from the domestic of M. Rakoczi, who happened to be a Pandurian. It has a subterranean connexion with the Rakoczi, and issues out of the same rocky mass, with a temperature of 9° R. = 52¼° F. Its flavour is more saline, and less agreeable than that of Rakoczi. It contains 76 grains of solid ingredients in 16 ounces, nearly ten less than its neighbour, but rather more carbonic acid (28 cubic inches). Its constituents maintain the same proportion throughout as those of Rakoczi, though on a slightly diminished scale (bromide of magnesium, 6-10ths; carbonate of iron, 4-10ths; culinary salt, 57 grains).

The *Theresienbrunnen* issues from a deep bore hole at a somewhat greater distance northwards, about two English miles. The water sparkles very strongly, and assumes a whitish appearance, from the quickly rising gas bubbles. Its taste is acidulous, saline, and rather piquant. It exhibits much analogy to the Maxbrunnen, containing 29½ grains of solid constituents, and 28⅓ cubic inches of carbonic acid. (It possesses no iron, but some bromide of sodium.) Temperature 9° Reaumur.

Ascending northwards from Kissingen for about a mile, salt and graduation works suddenly attract your attention, in the midst of charming meadow ground near the Saale. You enter, and are shown the so-called '*Soolen Sprudel,*' or '*runde Brunnen*' (salt bubbler, or round well), of very little importance before the year 1822, on account of its sparing supply. But after extensive boring processes, it discharges now a great abundance of water, with violent subterranean hissing and foaming—viz., every minute forty cubic feet, with 3½ per cent. of salt. The round shaft of this remarkable spring reaches a depth of twenty-five feet, with a width of eight feet. The water possesses a saline bitterish taste, and a temperature of 15½° R. = 66° F.

From its name you will be prepared to hear that it does not issue in an uninterrupted stream. But it does not throw its water up in the pulsating manner observed at Carlsbad. The natural phenomena noticed here are quite peculiar. You enter the enclosed space, you perceive a circular glass-covered prominence, with several persons around, and exclaiming, from time to time, 'It does not come yet.' All are perfectly still and watching. You inquire the meaning of this anxious expectation. Following the throng, and endeavouring to penetrate the subterranean darkness through the protecting glass covers, you wonder at the absence of all movement or bubbling. After having waited some time, you hear a distant undulatory movement, which becomes gradually stronger and more audible; the foaming and hissing soon become greater, and the eye will now perceive a whitish waving mass of water rolling more and more upwards, till it has reached its greatest height. If there are any boys amongst the visitors, they will never fail to make the experiment of placing a cap on the crown-like top of the enclosure. For a long time the cap rests immoveable. You will not, however, have heard the rushing sound long before, suddenly, the cap rises a little, and then is jerked with great force, as if by an invisible hand, into the middle of the room. You examine its former resting place, and you find a small, scarcely perceptible hole, through which the expansive force of the gas performed this feat. The expectant visitors hurry off now, when you would think it most interesting to watch and listen. But the cause is soon explained. Dr. Pfriem, the superintendent of this establishment, kindly shows the different baths that are waiting for the arrival of the Sprudel water. Here gas-cabinets are gradually receiving their quantum of carbonic acid conducted by pipes from the covering layer of the well, some for general, others for local gas-baths. There a '*Wellen-bad*' (wave-bath) is filling in a baignoire from a tap below, and we have an opportunity of admiring the constant wavelike motion, and formation of white foam in the unheated bath. In another chamber a '*Strahl-bad*' (radiating-bath) is getting ready from the same source, for another patient. A third waits for his gas-douche. After having maintained its height for about two hours, the water of the Sprudel sinks back rather rapidly with a distant rolling sound, and then requires a full hour to repeat its rising process. It might perhaps be more appropriately called the salt-tide, for the above phenomena are more analogous to a marine ebb and flow, than to Sprudel jerking.

This spring contains 187 grains of solid ingredients (about three times as much as the Pandurbrunnen) in sixteen ounces. Of these 107 grains are culinary salt, 25 chloride of magnesium, 25 sulphate of soda, with about $\frac{1}{3}$ of a grain of carbonate of iron. The following comparative analysis of the five springs will assist in their selection :—

	Rakoczy.	Pandur.	Max-brunnen.	Theresien-brunnen.	Soolen-sprudel.
Temperature	9° R.	8° 87	8°75	9°	15°6
Carbonic acid	26·25 cu. in.	28·85	31·04	28·35	30·57
Total of solid ingredients in 16 oz.	85·74 gr.	76·39	30·65	29·63	187.68
Viz.:					
Chloride of sodium	62·05	57·00	18·27	18·40	107·51
„ potassium	0·91	0·25	1·00	0·85	0·97
„ calcium	—	—	—	—	3·99
„ magnes.	6·85	5·85	3·10	2·75	24·51
Bromide of sodium	—	—	—	0·07	
„ magnes.	0·70	0·68	—	—	0·06
Carbonate of soda	0·82	0·03	0·38	0·39	
„ lime	3.55	5·85	2·59	2·00	1·65
„ magnes.	2·50	1·62	1·82	2·37	6.41
„ iron	0·68	0·45	—	—	0·35
Sulphate of soda	2·00	1·75	1·86	1·35	25·30
„ lime	2.50	0·75	0·65	0·75	
Phosphate of soda	0·17	0·05	0·12		
Silica	2·25	1·55	0·46	0·50	
Oxide of alum	0·18	0·05			
Organic extract	0.15	0·09	—	—	0·86
Loss nearly	0.38	0·37	0·38		

The effect of the Rakoczy water is not generally to increase the alvine actions; sometimes, on the contrary, it is rather obstructing. It agrees, therefore, best with persons suffering from atonic dyspepsia and laxity of the intestinal fibre, when excessive mucous secretion impedes the abdominal function.

In fact, a certain amount of weakness produced by age or exhausting disease is necessary for demonstrating the action of the water. It does not depress vital energy like the springs with predominant sulphates, but it rouses the nerves of the reproductive system, counteracts tough mucosity, and abdominal scrofula. Vigorous constitutions are less benefited by the water. The abundance of carbonic acid affords no small assistance in strengthening the power of the ganglionic nervous plexus. In hepatic enlargements and passive abdominal congestion, the Rakoczy water shows itself particularly beneficial. Dr. Maass mentions a case of hepatic induration, resulting from hepatitis; constant obstruction, abdominal distention, anorexia, indigestion, and emaciation, accompanied the complaint. The complexion of the patient was livid, with yellow colouration of the eyes, the liver considerably enlarged and hardened, the legs and right hand œdematous, besides occasional nocturnal perspirations and febrile orgasm. From 3 to 6 glasses of the Rakoczy water, with luke-warm Pandur and Soole baths, induced hæmorrhoidal flux with improved digestive function, but the volume of the diseased liver had not diminished after a week's course. The patient having left Kissingen with little hope of ultimate recovery, surprised the doctor ten years afterwards (Iahrbrüher für Deutschlands Heilquellen, 1840,) by his perfectly healthy and vigorous appearance. The use of the Rakoczy water had been continued by the patient at home until the gradual disappearance of the hepatic enlargement and other morbid phenomena. He was now about fifty years of age, and assured his former physician that he never enjoyed better health, even in his youth, than at that moment. An interesting instance is recorded of a young man, who, after some vexation, had been taken ill with a gastric fever of a slightly nervous character. Two months after his recovery, he was attacked by intermittent fever, which, notwithstanding the use of quinine, did not leave him for six months. Although freed from fever, he found his state of health greatly impaired. His complexion was pale and sallow, his appetite and sleep diminished, eructation and pressure on the pit of the stomach ensued after the mildest food; at the left hypochondrium the spleen was found enlarged and indurated. Action of the bowels was invariably retarded, sometimes from six to eight days. The skin felt dry and harsh, the feet were œdematous as far as the ankles. This patient used for eight weeks the Rakoczy water internally, and the Pandur externally, and was completely cured. As regards gout, for which disease Kissingen is often recommended, no favourable results can be expected in atonic, metastatic, or completely fixed gout, with deposits, contractions, or anchyloses; but when arthritic diathesis proceeds towards development under the influence of vicious and tardy bilification, the spa is often found to possess curative powers. Scrofulous patients are greatly benefited by the spa; not those of a florid, erethic character, but rather persons of phlegmatic and torpid constitutions. The Maxbrunnen is recommended in renal and vesical catarrhs, especially if complicated with hæmorrhoidal tendency. *Helminthiasis* is enumerated as one of the principal disorders curable by the Kissingen waters. A lady was freed of a tapeworm, eighteen yards long, after a course of four weeks, having been subjected in vain to the ordinary medical treatment for two years; but strict diet was enjoined, and, besides the internal use of the Rakoczy water, clysters of Pandur were simultaneously employed, all fresh from the source, with the smallest possible loss of carbonic acid. Analysis of the Rakoczy water perfectly explains its great utility in systemic atrophy, based on intestinal torpor, and its indication in abdominal derangements with the character of debility, occurring in real old age, where a diminished admixture of saliva seems to be rectified by the spa, or in the artificial old age superinduced in young persons by various causes.

You see, then, what different considerations should guide you in selecting either the sovereign of antibilious springs, or one of his neighbouring Bohemian courtiers, or the distant independent chieftain of Bavaria. Hepatic derangement is alleged and proved to be the principal disease curable by the Carlsbad, Marienbad, Franzensbad, and Kissingen waters.

How, then, are we to distinguish between them? If you will bear in mind the individualities which we have pointed out as peculiarly adapted for either of the former three, Kissingen must furnish the greatest chance of recovery, if a person be afflicted with a very tender alimentary tube, with frequent flatulence, eructation, want of appetite, alvine obstruction, general debility, emaciation or scrofulous puffiness; in short, if he require neither the highly-stimulating and penetrating efficacy of Carlsbad, nor the antiplastic and derivatory power of Marienbad, nor the tonico-solvent Franzensbad springs, but improved digestive action and heightened lymphatic circulation and nutrition.

Suppose the above patient with splenetic physconia asked your advice previously to visiting a spa; you would consider that there was abdominal inaction, probably more from the absence of certain inorganic materials, than from deep, invincible, vital torpidity; you would find his digestive canal unable to bear even mild nourishment without irritation: to raise his powers, you would not require a remedy producing functional vitality, as the *reaction* of a highly stimulating and overworking agent, but one calculated directly to improve the elements of nutrition, and to remove the impediments to a proper exercise of the organic functions. But Kissingen offers other curative means besides those enumerated. The mother-lye of the Soole is applied in glandular swellings with great advantage, both locally and by general baths. This contains in 16 ounces, 1925 grains of chloride of magnesium, 420 grains of chloride of sodium, 55 of chloride of lithion, the same amount of chloride of ammonium, 246 of sulphate of magnesia, 10 of bromide of magnesium; total, 2806 grains. The *salt-mud* is another medicinal preparation, sometimes obtained from the effluvia of the salt works, and sometimes from a little neighbouring pond, where carbonic acid arises from the ground. The circumambient air of the graduation works is not the least important curative influence reigning in this charming little town. Many patients with weakened thoracic organs, obstinate hoarseness, or pulmonary blennorrhage, find annually relief or cure here by drinking Sauerbrunnen with whey, and sojourning a certain portion of the day in the environs of the salt works. You must have remarked the great analogy between the baths of the so-called Soolensprudel and those of the sea. The temperature and composition are similar, excepting the additional presence of iron in the Kissingen sprudel. The baths are taken without heating or cooling, and though chilliness is the first sensation on entering, the great quantity of carbonic acid, with the wavy motion of sea-warm water, soon causes agreeable peripheric stimulation, redness, and warmth, very similar to the sensations resulting from real sea-baths. We have only to regret that so few persons can avail themselves at the same time of these baths, the difference of extent being so greatly in favour of the genuine sea. Many, perhaps, will smile at this pigmy comparison, and say, what is the use of an imitation sea-bath? Are we deficient in real sea-water or in conveniences for its employment? If baths are required with saline exhalations, and all the healing influences of the sea, let the patient resort to the sea-side and bathe in the abundant salt fluid, instead of waiting here for a puny measure of similar water. This objection seems very plausible, theoretically. But let us examine it in practice, and inquire whether the sea-side invariably restores those sunken powers for which it is recommended? Is strength imparted to each bather? Or does it not occasionally happen that the powerful shock of the mighty stimulus irritates, instead of invigorating? Is not the advantage of sea-bathing often counterbalanced by secondary morbid incidents? However useful and invaluable for combating morbid diathesis, you are well aware how carefully it must be avoided in all erethic conditions, and in many formed diseases. Often, then, when sea-bathing must be forbidden from certain medical considerations, such modification as you find here may prove extremely desirable, particularly with all the other auxiliaries at your command, for influencing both the internal and external reproduction of the weakened organism. You are aware that Kissingen is largely employed abroad, chiefly Rakoczy; but the Maxbrunnen well deserves to be used for exportation, on account of its felicitous combination, and of the close union of its carbonic acid. After having been exposed to the atmosphere for three days in open bottles, and placed in a heated room, a great quantity of carbonic acid is evolved on shaking the bottles. Many consider it preferable to Selters water in its dietetic use. Kissingen gains daily in importance, its efficacy being ranked between that of Carlsbad, for abdominal disorders, and of Wiesbaden, for derangements of the sero-fibrous and muscular system.

A case is recorded of a neighbouring physician who was suddenly seized with most violent pains of the stomach and vomiting, so that enteritis was diagnosed, and a corresponding antiphlogistic treatment adopted, but to no purpose. The pains continued, and paralysis of the extremities was at last added. An eminent Würzburg physician considered the disease as a form of masked gout, and therefore advised Kissingen. Affected with violent palpitation of the heart, he arrived at the spa, after nine months' suffering. After the lapse of a fortnight, articular gout made its appearance, but with the relief of the paralytic and neuralgic symptoms.

The beneficial influence of Kissingen on the portal circulation will prepare you to hear of its favourable action on abnormal catamenial flux. The majority of the valetudinarians, however, belong to the male sex; and diseases of the hypochondriacal organs annually swell the list of visitors in a preponderating degree. Besides the greatly esteemed German physicians (Dr. Maas, Dr. Balling, Dr. Welsch, &c.), the English visitors enjoy the advantage of the highly valuable services of Dr. Granville and Dr. Travis, who reside at Kissingen during the season.

Bocklet.—Let us now pursue the northward course of the river Saale, for about five English miles, and we shall arrive at *Bocklet,* situated in a meadow-valley on the left bank of the river, two leagues from Kissingen, the same distance from Neustadt on the Saale, six leagues from Brückenau, seven from Schweinfurth, and ten from Meiningen. At the eastern side of the valley, woody hillocks are perceived, less high than those of the opposite side. The meadow-ground presents a very pleasant, but rather monotonous appearance. The mountains as far as Kissingen consist of stratified sandstone. Thence layers of stratified limestone commence and extend through the southern part of the Würzburg domain. Towards the Rhöngebirg, on the other side of the Saale, basalt takes the place of sandstone. The springs were discovered, about 130 years ago, by the Vicar of Aschach, Schöppner, who accidentally remarked, on passing that way, a bog filled with yellow water and covered by a variegated pellicle. These peculiar characteristics, besides the unusual taste and smell, and the neighbourhood of Kissingen, excited in the reverend gentleman's mind the idea of its being a mineral water. He had an empty perforated cask dropped into the deepest part, and thus obtained a purer flow of the water, which he tried for his own ailment with success, and then induced many of the neighbouring inhabitants to follow his example and establish the fame of the newly-discovered fountain. A hundred years ago, the spring was inclosed and a bath-house erected near it. Several springs, formerly separate, were found to possess the same origin, and therefore received a common inclosure. The place now contains a chalybeate and a sulphurous spring. The former enjoys a high reputation for its solvent and tonic power. It discharges seventy-nine cubic feet of water per hour, and flows with a considerable hissing noise, sparkling strongly when drawn. Its taste is saline and somewhat astringent; temperature, 8° Reaumur; spec. grav. 10·117. The curious tide of the Soolensprudel seems to be feebly repeated here, for slight ebbing and flowing take place, although without regularity. The source sinks suddenly several inches in the shaft, and rises again with some violence, after a shorter or longer period. On some days no tide is perceived; on others, it occurs several times. It is most marked at the period of full moon, also at the approach of a tempest, and whenever the barometric scale is lowered; the carbonic acid gas being evolved at the same time in greater quantities and more energetically.

Contents of the chief Bocklet springs (cold).

	Ludwigsquelle. (Ludwig's sprg.)	Schwefelquelle. (Sulphur sprg.)	Stahlquelle. (Steel sprg.)
Carbonic acid	31 cub. in.	21½	39·3
Sulphuretted hydrogen	—	0·2	
Sum total of ingredients	45·9 gr.	5	27·6
Viz.:—			
Sulphate of soda	6·25	0·25	2·54
„ magnesia	—	—	3·23
„ lime	0·50		
Chloride of sodium	27·50	0·25	6·55
„ magnesium	0·75	—	4·43
Carbonate of soda	—	0·50	
„ magnesia	1·25	0·50	3·36
„ lime	7·25	2·50	6·54
„ iron	0·65	0·40	0·61
Silica	0·50	0·10	0·22

This combination of the sulphates of soda and magnesia with the carbonates of lime and iron, assisted by the presence of the anti-scrofulous chlorides, justifies the well-earned reputation of the spa in atonic irritation and mucosity of the alimentary mucous membrane, and especially in diarrhœa based on a scrofulous affection of the mesenteric glands, in anæmic states of the uterus, in blennorrhages, as well as in passive metrorrhage. As a remedy after the use of highly solvent springs, Bocklet is also very valuable, both for internal and external use.

About ten or twelve feet from the chalybeate, the less abundant sulphurous spring comes to light. This is only used for drinking, on account of its sparing supply. In dry, hot summers, the quantity of the water is still more diminished, with a somewhat increased proportion of hydrothionic acid. It displays the characteristic smell of the hepatic gas. On drawing a glass of the water, it loses momentarily its transparency, by reason of the rising gas bubbles. The sulphuretted hydrogen not being closely united to the water, it easily volatilises by lengthened exposure to the atmosphere. The layers of carbonic acid spread over the water are led off, and employed for gas-baths. Ferruginous mud is obtained from the so-called red peat of the high Rhöne, and used for mud-baths. There are two other kinds of moor, of large extent, and forming considerable bogs, which are, however, less appropriate for medicinal use. Motherlye, from the brine of Kissingen, is sometimes added to the baths, or used for local application. From the already explained action of the constituents, the water agrees even with very weak and irritable digestive organs, where other chalybeates would be less easily tolerated, from the want of tempering salts. The chalybeate of Bocklet ranks in its medicinal effects between the more purely tonic Pyrmont, and the more solvent Franzensbrunnen. The atony of the mucous membrane is particularly counteracted by Bocklet.

Whilst assimilation and reproduction are greatly heightened by the use of this water, atonic irritability of the nervous system is allayed. Bocklet enjoys the highest reputation in atonic uterine diseases, in chlorosis, menstrual irregularities, sterility, and blennorrhages; and here, especially, potent efficacy results from the careful employment of the *douche ascendante.* Dr. Kirchgessner detailed to me several cases of sterility and tendency to abortion that had been cured by the internal use of the Stahlquelle and the above-mentioned douche. The liquid is jerked up with different and gradually increasing degrees of force, an experienced female bath attendant directing the machinery. I especially inquired whether erotic sensations resulted from the introduction of this remedy, and was assured by the Doctor, that generally it produced no other physical effects than those of ordinary vaginal injections. Occasionally, however, some sexual erethism is induced, and then the douche is considered as inapplicable, and immediately discontinued. I need not dwell on the importance of this point, for if the excitement of such sensations were continued, it is obvious that the previous atonic irritability and torpor would, after the subsided reaction, increase rather than diminish. If the uterus is chiefly to be acted upon, a stream is led through the douche, whilst for the affected vaginal portion the perforated tube is used to impart an ascending rain-douche. From my own observation, I can state that it is never employed by Dr. Kirchgessner without the greatest care and circumspection; and I can unhesitatingly recommend Bocklet in cases of sterility, where leucorrhœa has formerly existed, and is prone to reappear by any weakening or exciting incident; when nervous susceptibility is connected with abnormal digestive function; frequent obstruction alternating with occasional diarrhœa; when menstruation does not maintain its regular epochs, though the signs of obstinate chlorosis are absent, and there is no positive appearance of anæmia or great debility in the complexion or posture of the patient. Let us imagine her to be every now and then seized with spasms of the stomach, neuralgia of the head, face, or teeth; her mind being extremely excitable for joy or grief, &c. To such a condition the Bocklet water is peculiarly applicable. Patients, however, of great debility, affected with a high degree of chlorosis, and with a greater sexual torpor, but with unimpaired alimentary function, will require a purer chalybeate. When scrofulous dyscrasia is complicated with the sexual disorder, Bocklet claims the preference. In several cases of ovarian tumour, the Doctor used emollient decoctions with cicuta for the *douche ascendante,* besides the sulphurous water internally, and baths of motherlye, until the complete removal of fluor albus and sterility, which had been connected with the organic disorder. The sulphur spring agrees well even with very weak digestive organs. It exerts a very beneficial influence on the alimentary and urinary mucous membranes, and is used with benefit in vesical hæmorrhoids and catarrh, and in hydrargyrosis. But of course you will not recommend Bocklet when the properties of a sulphurous mineral water are required for the cure of disease, having to choose between so many powerful springs of this class: but when you consider Bocklet's muriatico-chalybeate spring useful, complications may exist or arise, which must be counteracted by the sulphur spring. For though weaker than many others, its quantity of carbonic acid, iron, and lime, gives it a preference in many morbid modifications.

LECTURE XI.

BRÜCKENAU.—HOMBURG.

GENTLEMEN,—By riding westward for a few hours across the Rhön mountain, we arrive at the charming valley enclosing the magnificent spa of *Brückenau,* situated on the little river *Sinn,* which runs from north-east to the south-west, between woody hillocks covered with oak and fir trees. The height observed on the south is called the *Sinnberg.* The spa lies about half a league from the small town of Brückenau, six leagues from Bocklet (eastward), the same distance from Fulda (northward), and sixteen leagues from Würzburg (southward). It possesses three springs. The Brückenauer, or steel spring, lies nearly in the centre of the valley. Two hundred yards to the south we perceive the Wernarzer, and about twenty yards farther, at the foot of the Sinnberg, the Sinnberger spring. The two first are separated by the river Sinn, which is here crossed by a stone bridge leading to the Curplace. Between the town of Brückenau and the spa an umbrageous beech grove borders both sides of the road, which all at once terminates by the unexpected view of the beautiful gardens, walks, and buildings, surrounding the springs. The Curhaus, erected by his Majesty King Ludwig of Bavaria, is one of the most splendid buildings of Europe. The walks and shady resting-places are varied and numerous, and abound in natural charms. The Dreystelz, rising above the Sinnberg, affords a very fine prospect of the environs. The steel spring arises out of rocks at the depth of fifty feet, and is conducted upwards by a wooden pipe. The water is clear, and strongly sparkling, with an agreeably acidulous, piquant, and slightly astringent taste. When drawn, it quickly covers the sides of the glass with gas-bubbles. If the water be exposed in an open vessel overnight, round, reddish flakes will be perceived at the bottom next morning. Red ferruginous ochre becomes deposited at the sides of the basin into which the water flows from the pipe. Only 2½ grains of solid constituents are contained in a pint of water—viz.,

0·60 sulphate of magnesia.
0·20 sulphate of lime.
0·65 chloride of potassium.
0·30 chloride of sodium.
0·55 carbonate of lime.
0·25 carbonate of iron (¼ of a grain); and
35½ cubic inches of carbonic acid; temperature between 7° and 8° R. Specific gravity, 1·006.

Brückenau may thus be considered one of the purest chalybeates of Europe, the iron being so finely divided and dissolved, and so little counterbalanced by antiplastics, that it possesses a purely tonic action without any secondary result. The sulphates and chlorides present are just sufficient to cause the chief ingredient to be well tolerated by the digestive organs. The great abundance of carbonic acid assists in directly introducing this invigorating element into the circulating fluids. The spa is therefore applicable in many cases of erethic atony, where other chalybeates would cause too great an excitement in the vascular system. After tedious recovery from exhausting ailments, in chlorosis, profuse perspiration from cutaneous weakness, or tendency to abortion, it is highly recommended. It is often used with great advantage after a course of Kissingen or other highly solvent waters. The Wernarzer spring is not a chalybeate, but one of the purest so-called acidulous springs in existence, containing 28 cubic inches of carbonic acid, with only 4-5ths of a grain of solid constituents, and among these 1-20th gr. of acetate of potash. The Sinnberger contains less than ¾ of a grain of constituents, with 25 cubic inches of carbonic acid. It was found necessary to dig 50 feet through the sandstone to enclose the latter, and the supposition was entertained that it originated out of lava-mass, probably lying here under the sandstone.

This would account for the great abundance of carbonic acid from the lava exhalations, whilst the deficiency of solid ingredients would be due to the small solubility of the superposed rocky masses. The taste of the two latter is purely acidulous and slightly pungent. They have been greatly extolled in chronic diseases of the pulmonary mucous membrane, and in lithiac and hæmorrhoidal tendencies. They are also often recommended in such chronic diseases as are based on abdominal obstruction, repressed piles, rheumatism, or gout. In fluor albus and dysmenorrhœa, they are also said to have been employed advantageously. Dr. Wetzler relates the case of a young delicate married woman, who was often affected with spitting of blood, and became so reduced after a severe delivery, that her condition was thought hopeless. She came to Brückenau, and Dr. Schipper, under whose care she placed herself, ordered first the Sinnberger, and afterwards the Wernarzer water, to be drunk, by which means she was completely restored. She had been confined subsequently, and was well at the time Dr. W. mentioned her case. The situation and climate of Brückenau are very favourable for persons with delicate thoracic organs. The variety of natural and artificial attractions here is particularly striking. The fine prospect offered by the Prince's house, standing on an eminence which overlooks the valley with its park-like walks,—the gardens between the costly buildings, with their shady groves and well-contrived orchards,—the giant oak with its immense horizontal branches, affording shade to more than 100 persons, and often serving as a centre for music and dancing,—the manifold walks on the other side in the woods of the Sinnberg, with their green benches or turf seats,—all these charms seem little appreciated, for I find that this spa, the favourite seat of his Majesty the late King Ludwig of Bavaria, decreases annually in visitors. When I walked last year through the magnificent Cursaal with its royal galleries and glittering chandeliers, its extensive space and accommodation for great numbers, almost deserted, I was sadly impressed by the absence of the only ornament wanting—viz., a lively throng of human beings. I understood that numerous visitors were attracted by the sojourn of his Majesty, the greater part perhaps from the natural fondness for courtly splendour, their numbers being increased by numerous Bavarian subjects, employés, and others who wished to petition the king, and who found him here more accessible than in his capital.

The above shows you, Gentlemen, that it is necessary to inquire into many circumstances, not immediately connected with the physical or chemical character of a spa, in order to arrive at a just conclusion as to the esteem in which it is held by the public. Many a visitor, with an anxious face, you might have met and set down as a valetudinarian, when in reality his chief complaint might have consisted in some unexpected addition to his family or expenditure at some hundred miles distance. But what is the cause of the present comparative loneliness of a place offering the purest chalybeate and acidulous spring, with all the characteristic effects of these two classes? This may partly arise from the fact that the supply is rather deficient, for the baths are not given of the pure steel spring, but the Wernarzer and Sinnberger non-chalybeates are heated and mixed with the former. As regards the acidulous springs, with their alterative and stimulating influence on the pulmonary, digestive, and uropoietic mucous membranes, they are probably often neglected in favour of springs which, possessing greater combinations, are suited to more complicated morbid conditions. At the time of my visit, an English nobleman, (the ambassador at Paris, I believe,) had just arrived to drink the waters for a fortnight, after a course of Kissingen; and I do think, whenever circumstances allow the delay, many of the frequenters of Kissingen would be greatly benefited, if, before returning to their usual toils or avocations, they would submit themselves for a few weeks to the tonico-solvent power of Bocklet, or to the purely invigorating Brückenau; they would certainly then carry home a much greater resisting power against morbific causes, by having provided their depurated abdominal organs with the strengthening chalybeate draughts, imbibed amid all the charms that nature and artistic skill can furnish.

Homburg.—We have now, Gentlemen, to direct our way to Frankfort, and for that purpose we might either ride northward to Fulda, or southward to Hammelberg. I would advise you, however, to avoid this backward movement, and rather to hire a private conveyance to take you to Sclüchtern, a few leagues to the west, where the diligence coming from Fulda will take you up at eleven P.M., and bring you, in about seven hours, to Hanau on the Kinzig. Thence the railroad will convey you to Frankfort in half an hour. This beautiful and busy town, full of life, pleasure, and commerce, forms the centre of extremely numerous and varied medicinal springs. They have on the north-west Homburg, on the north Nauheim, on the west Soden, more southerly Weilbach, and due westerly Wiesbaden, besides the celebrated Nassau Spas at a short distance. Our next visit, however, is intended for Homburg 'vor der Höhe,' which we reach by post or omnibus; or by taking a ticket at the northern railroad, you will be carried by steam as far as *Bonamös*, and here the 'Stellwagen' waits, with its three horses, to bring you to the spa. This spring was visited by 805 guests only in the year 1837; by 4600 nine years afterwards, in 1846; and by upwards of 5000 in 1847. It lies 600 feet above the level of the sea (300 feet higher than Frankfort), on a mountain-ridge, about two miles distant from the south-eastern chain of the Taunus. Woody hills protect the town on the north and west. The highest peak of the Taunus, the *Feldberg*, lies in a due westerly direction. Towards the south-west rises the Altkönig, with the ruins of Falkenstein at its feet. It is open and unprotected on the south and east. At a greater distance, the Donnersberg is perceived to the south, the 'Bergstrasse' and the Odenwald to the south-east; with these you notice on the map the more easterly parallels formed by the Spessart and Rhön mountains. The air is considered very bracing and invigorating in the months of June, July, and August. In spring, the temperature is very changeable; and even in summer, it is positively injurious to persons with delicate thoracic organs. The mountain-masses round Homburg consist of quartz-slate, whilst of the Soden mountains chlorit-slate forms the chief foundation. At the foot of the mountains, clay-slate with quartz veins is found. Though tertiary layers of lime are frequent about Soden, no lime can be discovered in the superficial crust of the environs of Homburg. On the other side of the Nied, however, fresh-water shell-lime is found in abundance. Strata of peat exist near Homburg with superposed basalt cones. The mineral sources originate to the north-east of the town, in a meadow-valley within a circuit of a few thousand feet. In boring, a thin layer of gravel was first penetrated; then a considerable stratum of differently coloured clay (150 feet); then a thick vein of quartz was arrived at, out of which the springs issue with their extraordinary abundance of carbonic acid. At a greater depth, efflorescent clay-slate is mixed, here and there, with quartz-sand. The origin of all the springs is shown to be common by their possessing nearly the same constituents. The water merely rises to the surface of the ground, so that deep canals had to be cut, to cause its efflux.

About two hundred years ago, salt was obtained from various bore-holes, but from some cause or other, the graduation-works were discontinued, and the buildings sold to the administration of the Nauheim Saltworks (1740). The place remained unnoticed till some boys, in 1809, discovered an acidulous spring, which was used as a refreshing beverage by the townspeople; but no medicinal employment was thought of before 1834, when Medicinalrath Dr. Trapp tried the now-called Elisabethbrunnen with success, and recommended its further employment. This spring is entirely protected by its enclosure from any atmospheric influence. The others are more liable to slight changes from accidental causes.

The Elisabeth spring comprises several confluent sources, provided with one enclosure. The others are the result of boring trials. It was found necessary to bore to a depth of 140 to 150 feet before a mineral fountain was discovered. The water furnished by the springs is clear and transparent, and issues with a constantly bubbling motion, from the great amount of carbonic acid present, which renders the saline, bitterish, and ferruginous taste somewhat pungent. Exposed for some time to the atmosphere, turbidity ensues, with a reddish deposit. At the boring-springs, a blackish powder adheres to the sides, chiefly composed of sulphuret of iron. Analysis of the four springs shows :—

	Elisabethqu.	Kaiserqu.	Stahlqu.	Ludwigsqu.
Chloride of sodium	79·15	117·04	79·86	7·93
„ magnesium	7·76	7·86	5·32	3·06
„ calcium	7·75	13·32	10·66	7·28
„ potassium	—	0·29	0·17	1·71
Sulphate of soda	0·38			
„ lime	—	0·19	0·14	0·15
Carbonate of lime	10·98	11·10	7·53	5·74
„ magnesia	2·01	—	—	0·09
„ iron	0·46	0·80	0·93	0·41
Silica	0·31	0·33	0 31	0·10
Total	109·31 gr.	150·93	104·97	86·04
Free carbonic acid	48½ cub. in.	55	46·9	43·35
Specific gravity	1·0115	1·015	1·0108	
Temperature	10° R.	11° R.	10° R.	10½°R.

The presence of sulphuretted hydrogen in some of them may be ascertained by the odour, but it is not chemically demonstrable. The effects observed at Homburg quite coincide with the properties of the component parts. The chief ingredient, chloride of sodium (four scruples), not only gently stimulates the mucous membranes to an increased secretion, but also loosens the formed and tough mucus, and thus prepares the alimentary contents for elimination, without actually operating as a purgative. Chloride of calcium (7¾ gr.) has been found to act beneficially in scrofula, being somewhat analogous to chloride of baryum in its solvent and alterative effects. It increases absorption in the lymphatic vessels, and seems to induce resolution in tumefied glands. The isolated remedy is not so favourably received by the alimentary tube as the sodium salt, being apt to over-stimulate and retard alvine functions, if employed to excess. The chloride of magnesium ($7\frac{3}{4}$ gr.) assists the action of the calcium salt. From the circumstance of those springs which contain the greatest quantity of chloride of magnesium particularly increasing bilious alvine evacuations, this salt is supposed to promote the secretion of bile. The rapid removal of mesenteric scrofula by Homburg-water, is chiefly ascribed to the presence of these two chlorides. Carbonate of iron to the amount of nearly half a grain (0·46), increases the tone of the blood, and prevents the development of cachectic liquefaction. It enables the organism to carry out the reaction by which the penetrating solvent treatment will be succeeded. The considerable amount of carbonate of lime (10 3-10th gr.) would rather act as an obstruent in its ordinary form, diminishing serous and mucous secretion by its absorbing tendency; but some modification must be allowed here, from its being accompanied by so great a quantity of carbonic acid. The duration of its contact with the abdominal organs becomes shortened by a prompt imbibition into the circulating fluids, and thus it assists the antacid and sedative effects of magnesia (2 gr). The absence of carbonate of soda in the Elisabethbrunnen is significant. These combined ingredients might display very different effects, if they were not introduced with an abundance of free carbonic acid (48 cubic inches in 16 ounces), which, according to Professor Liebig, surpasses the quantity found in any other spring in Europe. It is therefore not remarkable that a sort of giddiness, and momentary feeling of intoxication, are sometimes perceived by persons of a plethoric habit who drink the water off quickly. The uropoietic and peripheric systems must, in such a case, perform their task of freeing the system from effete gaseous and liquid particles, when calmness and equilibrium will again be restored. The pulse is often increased during the use of the water, which must be partially attributed to the unusual quantity of free carbonic acid.

The Homburg water causes a sensation of warmth in the stomach, occasionally with some flatulence, which, however, is soon relieved by eructation, or increased alvine evacuations. If renal secretion appear augmented, the action of the bowels becomes less perceptible. Sometimes even obstruction takes place in the beginning of the course. Unless accompanied by unfavourable signs of vascular excitement,—as giddiness, headache, abdominal distention, restlessness, &c.,—the action of the water alone may be trusted for the production of the necessary eliminations. It must be obvious, that one organism will be benefited by imbibition and assimilation of the chemical constituents, whilst another will urgently require for the normal performance of its functions the removal of tough and impeding materials. Should the watchful physician observe any symptoms of cerebral congestion, he will not hesitate to employ an energetic revulsive treatment, by purgatives or otherwise. From two to four tumblers are taken fasting, and ordinarily some fæcal and mucous evacuations follow in a few hours. If they exhibit rather a serous character, they are not considered favourable, and the dose of water should be diminished, or dietetic measures taken to change the diarrhœal disposition. Critical excrementitious stools happen during the course with great relief. Morbid corpulency becomes considerably diminished, and digestion improved. Three weeks is the ordinary duration of the course; prolongation of this period would cause too great an irritation of the alimentary canal. Towards the third week the relief experienced at first generally vanishes, abdominal action slackens, the parietes distend, with general lassitude and languor; appetite, sleep, and temper become disturbed. These signs are merely the beginning of critical reaction, and you must particularly exhort your patient not to be discouraged by them. The alterative process has been commenced, repressed piles or catamenia will be reproduced by the reacting efforts of nature; hardened fæces, and even gallstones, will be expelled, and the whole reproductive system will often become strengthened after the cessation of these phenomena.

Homburg has been found very beneficial for aged individuals who have undergone typhus or other weakening diseases, and who have an instinctive desire for more nourishment, with inactive intestines and a feeling of discomfort after alvine evacuations. Their blood seems to be deficient in certain materials necessary for a proper innervation, and therefore restoration and cure may ensue by the use of the springs. Experience has shown Homburg to be adapted to general scrofulous diathesis without local derangement, and to swelling of the mesenteric glands, with emaciation, and helminthiasis; to ulceration of the subcutaneous glands, scrofulous blennorrhages of the eyes or ears, &c. But in the case of infants, no irritation must exist in the infantile digestive canal, if Homburg is to be administered internally; the course is therefore generally commenced with baths. In florid erethic scrofula, the internal use is entirely contra-indicated; whilst in the torpid form, careful employment of Homburg exerts a decidedly curative effect. Whatever analogy may exist between tubercle and scrofula, it has been positively shown that no favourable result can be expected from Homburg in tubercular deposits. Even in cases of hæmoptoë and pulmonary irritation that were relieved during the course, under the appearance of hæmorrhoidal congestion, aggravation of the disease ensued some weeks after the return from the Spa. The cause of this important circumstance is not so much to be sought in the climate as in the chemical composition of the water.

The Spa is particularly indicated in prevailing venous congestion of the abdominal organs. When scrofulous dyscrasia has existed in youth, mature age is liable to venous predominance in the circulating system. Less arterial blood being required now than during growth, when constant organic additions took place, unchanged sanguification may produce more of this vital liquid than necessary for renewal of the wasted materials. This condition is remedied either by diminishing the quantity of nourishment, or by increasing the function of the emunctories. If, however, luxurious meals are indulged in, and abdominal and cutaneous eliminations are checked through mechanical compression, lengthened sojourn in a confined atmosphere, avoidance of muscular exertion, &c., abdominal plethora must occur, and over-filling and distention of the portal system naturally ensue; the impeded venous reflux impairing the strength of arterial movement. The blood flows with diminished force, and thus furnishes a less active stimulus for metamorphic processes. The ganglionic nerves make energetic efforts to counteract this torpidity, and become irritated and weakened in consequence. Dyspepsia, flatulence, irregular stools, colic, headache, mental depression, occasional pains in the back, fulness of the abdomen, and other signs of faulty digestion, torment the patient. This state may be relieved by the effort of nature in discharging venous blood through the hæmorrhoidal vessels; but if the causes continue, the abnormal state will be renewed. This morbid state frequently finds a radical cure at Homburg. Although at first the secretion of acid mucus often augments under symptoms of apparent aggravation, this soon yields to relieving evacuations. Gall-stones are frequently removed by the water.

Icteric phenomena are generally aggravated at first, the skin assuming a deeper yellow, till critical evacuations usher in the expected relief. *Melæna* and vomiting of blood are often connected with intumescence and congestion or softening of the spleen. Such cases find a powerful remedy in Homburg.

If enlargements of the liver or spleen be produced by intermittent fevers, these latter sometimes reappear during the course, and require medical treatment; but through the simultaneous use of the Spa, the hypochondriacal derangements often disappear with the fever. In diseases of *the uterine system,* especially in abnormal menstruation, Homburg enjoys a very high reputation, probably due to its powerful anti-venous action. A general torpid and phlegmatic state is most in need of this Spa. In some cases of *chlorosis,* Homburg will exert a more curative effect than steel springs. Indeed, though the *character* of this disease is generally pretty similar in different individuals, we must allow a great variety of causes. To counteract these must be our aim. There will be, doubtless, deficiency of iron in the composition of blood; but we must inquire how this has been produced. Have hepatic and intestinal functions been previously disturbed? Has not the patient sometimes suffered from bilious vomiting, acidity, or other signs of irritable digestion? So that the attenuation of the blood results more from imperfect assimilation, than from absent elements. The reason why in such cases pure chalybeates are useless, is obvious; and here Homburg acts as a powerful curative agent. Digestion and bilification improve, mucosity and venous predominance are allayed, and the restored digestive function renders further tonics unnecessary. *The spasms of the stomach,* which often accompany the menstrual epochs, are invariably relieved here. Uterine hypertrophy is diminished, and thus sterility, as well as excessive catamenia, is cured. Vesical catarrh, and hæmorrhoids, with frequent ischuria and cramps of the bladder, are likewise greatly mitigated.

Homburg is contra-indicated in fever, acute inflammation, congestion to the head or chest, organic diseases of the heart and great vessels, dropsy, internal suppuration, &c. Taking cold is particularly to be avoided during the course, as it materially interferes with the effect of the water. To show the advantageous result of Homburg in digestive weakness, Medicinalrath Dr. Müller records the case of a lady who had been confined to her room for more than a twelvemonth, in consequence of a chronic nervous complaint. Complete anorexia, with a furred tongue and obstinate obstruction, was gradually developing, and resisting various energetic modes of treatment. At last Elisabethbrunnen was resorted to. The water was found to agree with the patient, although it had to be taken without exercise, as she was unable to leave her bed. After a fortnight, the tongue became clean, and alvine action more regular. In the course of five weeks her digestion was perfectly restored. Other cases are mentioned of cachectic, emaciated individuals, affected with pertinacious obstruction, occasional colic, vomiting, and diarrhœa, who were restored by using the Elisabethbrunnen during three or four weeks. Another case is detailed of an individual, with morbid obesity, frequent sleepiness, irregular stools, but unnatural appetite. From neglect of exercise, the slightest exertion had become attended with difficulty. This condition was likewise greatly improved by the Spa. In cases where active life has been exchanged for a sedentary occupation, the injurious results developed in the abdominal organs are extremely well combated by Homburg. Several cases are recorded of ladies who had been afflicted with frequent paroxysms of 'cramps of the stomach.' Alvine obstruction was present at the same time, and only yielded after a week's course of the Elisabethbrunnen. An elderly *bon vivant* was suffering from violent and frequent attacks of colic, with obstruction: he used other Spas during ten years, with only temporary relief, but was ultimately restored at Homburg. Medicinalrath Dr. Trapp details several cases which may serve as a useful guide for the proper choice of the Spa. Mons. de P——, muscular and strongly built, but rather puffy in appearance, had suffered from *febris intermittens* several years ago, when residing on the borders of Holland. Formerly he complained much of obstruction; now diarrhœa is more frequent, with occasional acidity and mucosity, feeling of soreness, and tickling in the throat: after meals, great lassitude and reddened face. His parents also suffered from weak stomachs—the father from gout. Two glasses of Elisabethbrunnen were ordered to be taken in the morning at long intervals, after a bath of 22° Reaumur, with motherlye. The dose and duration of bath were gradually increased, and restoration followed. Mr. R., fifty-two years of age, is perfectly healthy, can eat and drink what he likes, sleeps well, but an intolerable pressure on the pit of the stomach never fails to succeed the meals, with eructations and redness in the face; he is inclined to diarrhœa, but has usually one tough, dry evacuation every day, with occasional pain and swelling of the foot balls. Three tumblers of Elisabethbrunnen produced from six to eight discharges of green, slimy masses, with great relief, but pulsation appeared in the epigastrium, with a metallic taste in the mouth. The dose was diminished in the morning, but two glasses given at night, with sitting-baths of 22° R., and of five minutes' duration. Restoration ensued. Several cases of abdominal plethora, with the characteristic *pulsat. abdom.*, are detailed, which were entirely cured by Homburg water.

In conclusion, Homburg is decidedly useful in abdominal plethora without inflammation or inflammatory tendency, occurring after intermittent fever, engorgement of the liver and spleen, and in *inactive circulation of the portal system,* according to the experience of Medicinalrath Dr. Trapp. Intermittent pulse, with faulty action of the right ventricle, based on abdominal derangements, is frequently cured here; also persons suffering with profuse menstruation (through passive engorgement of the uterus) and periodical cramps of the stomach. Increased diuresis almost invariably takes place, if the result is to be favourable. Some cases of intermittent fever, which had resisted a persevering employment of quinine, were also cured here. But to act healingly, the Elisabethquelle must be well digested, and therefore requires an *uninjured alimentary tube.* A highly-esteemed English physician (Dr. Prytherch) gives his valuable services at Homburg to those invalids who seek his advice, besides the greatly respected German physicians mentioned above.

To choose between Homburg and Kissingen, we have again to lay almost a greater stress on the constitutional peculiarity of the patient than on the affected organ. You find great analogy in the composition and the altitude of the two Spas, as well as a great difference of climate. The atmosphere of the open Homburg, however bracing and invigorating for the weakened nervous system of the pure hypochondriac, is injurious to persons with irritable thoracic organs: incipient or latent tuberculosis is more quickly developed. In Kissingen, patients with the same morbid disposition (for the cure of which they were not sent there) find a beneficial influence produced on the organs of the chest; previous irritation is allayed, excessive mucous secretion diminished, and tubercular development retarded. A spring exists there directly benefiting the respiratory organs.

But let us now review the morbid phenomena which seek direct relief at either of the Spas, and for this purpose we must refer in the first instance to the constituents. They both possess chloride of sodium as chief ingredient (Homburg in greater quantity—about a scruple more), some chloride of magnesium (in both the tenth part of the former ingredient); carbonate of magnesia is contained in both (Homburg, 2 grains, Kissingen $2\frac{1}{2}$ grains); both possess iron (Homburg 4-10ths, Kissingen 6-10ths). According to these ingredients, Homburg ought to act as a more energetic abdominal solvent, and as less heating and irritating than Kissingen, yet we find the reverse to be the case. I have shown that digestive atony, hepatic enlargement, and even induration, find a cure in the use of Rakoczy, whilst I have just stated that Homburg requires an uninjured digestive tube, but with obstructed abdominal circulation. Homburg is contra-indicated in general atonic erethism, where Kissingen is recommended. The explanation of this difference will be easy, if you pursue the chemical comparison further. Homburg possesses chloride of calcium ($7\frac{3}{4}$gr.), which is absent in Kissingen. It further contains three times as much of carbonate of lime (11 to $3\frac{1}{2}$ grains). This higher proportion of calcium and lime is only to a certain extent compensated by the greater amount of carbonic acid (48 cubic inches to 26). I would not ascribe any therapeutic difference to the sulphate of soda of Kissingen (2 grains), as it is counterbalanced by an equal quantity of gypsum, besides an unusual proportion of silica. A due appreciation of the above analogies and differences will readily explain the beneficial results produced by the use of chlorides, with a great superabundance of the stimulating carbonic acid of Homburg, on the one hand, and the modified action of the analogous ingredients of Kissingen, on the other, where a smaller proportion of chlorides and carbonic acid is combined with a greater amount of iron.

LECTURE XII.

SODEN.—WIESBADEN.

GENTLEMEN,—We now leave the pleasant neighbourhood of Homburg, and return to the Bonamös station. Thence we might proceed to Friedberg, and visit the neighbouring Nauheim; but reserving this for a future occasion, we shall return to Frankfort and direct our steps to *Soden,* in the west. By means of the Taunus railroad (with the *Höchst* branch) the three leagues distance is performed in 25 minutes. Soden lies in a valley (lat. 50°, long. 8° east) at the foot of the southern declivity of the middle Taunus, which extends from the west in an easterly direction. Mainz is situated at a distance of five leagues to the south-west(reached in an hour); Wiesbaden, six leagues to the west (reached in an hour and a half); Homburg three leagues to the north. Orchards and vineyards adorn the hills which enclose the Spa on the east and west: to the south, arable land gradually rises. Looking towards the north, the woody promontories of the Feldberg and Altkönig arrest the visitor's eye. The whole appearance is that of a calm, peaceful village. Its altitude above the sea is 437 feet (about 100 feet higher than Wiesbaden). The boundaries described above indicate the extreme mildness of the climate; thoroughly protected as it is, without being, on the other hand, too much narrowed. Violent north and east winds are kept off by the sheltering Taunus, whilst the cheering rays of the sun freely enter from the south. The crust of the valley is partly a peaty soil, and partly covered with rich pasture. It furnishes to the air the necessary humidity without any stagnated bog. In boring, saline springs are invariably met with, so that no sweet water can be obtained without conducting it from the neighbouring mountains. The saline character is likewise communicated to the vegetation, which resembles that of sea-shores. Plantago maritima, Salsola kali, &c., were frequent formerly. Their present rarity is owing to the progressive cultivation of the soil. Insects characteristic of sea exhalations were not wanting, as bledius tricornis, cœnia natophila, &c. The evaporation of saline water from the ground is favoured by the warm temperature of several springs. The extreme mildness of the climate is further evidenced by the character of the vegetation. The grass of the juicy meadows admits of being cut three times a year. A great variety of fruits, corn, and vegetables luxuriate in the valley, while vineyards cover the sunny declivities. Endemic diseases are said to be unknown here; but scrofula, though rare, is not completely absent; altogether, the inhabitants appear healthy and vigorous.

The mineral springs arise out of slate-stone. The Taunus itself is composed of two chief groups,—the one forming a variety of chlorite-clay, and talc-slate, prevails in the middle and southern declivities, whilst quartz-rock chiefly occupies the northern parts. The numerous Soden springs discovered in this narrow compass show their common origin by qualitative similarity, though they differ materially in temperature, quantitative proportions, and supply. It is supposed that water arises warm from the depth, and becomes exposed to different cooling influences, according to the more or less circuitous route it has to perform previous to its superficial issue. The springs all lie in a plain of 400 feet, by 2400 feet. Beyond this, neither evolution of gas nor any efflux of mineral water is observed. No less than twenty-three springs come to light in Soden, but only those claim our consideration which are enclosed for use. The water is clear and transparent, constantly agitated by rising gas bubbles. The taste is more or less saline and acidulous according to the greater or smaller amount of salt and carbonic acid. Spring 19 possesses a particularly piquant flavour, and is called the *Champagner-*

brunnen. Some have, to a certain degree, the taste and smell of sulphuretted hydrogen, especially No. 6, called the *Schwefelbrunnen* (sulphur well). The temperature varies considerably; some have only from 9° to 12° R., whilst most of the others are lukewarm, their temperature ranging between 15° and 19° R. Exposure to the air causes the water to become turbid by the disengagement of gas-bubbles, and ultimately a yellow-reddish precipitate of oxide of iron takes place.

Fine flocculent ochre covers the side of the enclosures, forming a yellowish gelatinous mass, hardening into a brownish substance at some distance from the source. It is most abundant in those springs which possess the greatest amount of salt, irrespective of the total quantity of solid ingredients. Ochre, formed by the precipitation of iron, contains, according to the microscope, infusoria belonging to the class of *gallionella ferruginea,* in different degrees of development, and chiefly composed of iron and silica.

The *Milch,* or Kurbrunnen (No. 1), possesses 22½ grains of solid constituents and 13½ cubic inches of carbonic acid in a pint of water; temperature, 18½° R., about 74° F.; specific gravity, 1·003.

The Winklerbrunnen (No. 2), 51 grains, 18½ cubic inches of carbonic acid, 14½° R.

Gemeindebrunnen, or *Warm* (No. 3), 32¼ grains, 14 9-10ths cubic inches of carbonic acid, 17° R.

Salzquelle unter der Brücke, or *Soolbrunnen* (saline spring under the bridge) (No. 4), 119¾ grains, 5¾ cubic inches of carbonic acid, 16° R.

Sauerbrunnen neben dem Schulhaus (No. 5), 57¼ grains, 15 cubic inches, 11° R.

Wilhelmsbrunnen (No. 6 A).

Schwefelbrunnen (No. 6 B).

Wiesenbrunnen (No. 18).

Champagnerbrunnen (No. 19).

The analysis of the most and least impregnated spring will sufficiently indicate their chemical composition—

	Salzquelle, (No. 4.)		Milchbrunnen, (No. 1.)
Chloride of sodium......	109·90	....	17·68
„ potassium	1·07	....	0·16
Sulphate of lime.........	0·65	....	0·19
Carbonate of lime	6·39	....	2·73
„ magnesia	1·35	....	1·37
„ iron	0·21	....	0·16
Silica	0·18	....	0·16
Alumina	0·62	....	0·01
Total	120·31	....	22·51

The diuretic effect of the water is most perceptible after a few days. Feculent evacuations soon follow in moderate quantity. Watery and numerous stools are considered unfavourable, and require diminution of the dose.

According to Medicinalrath Dr. Thilenius, appetite invariably improves under the use of the water. The same spring occasionally appears to the patient to have assumed a more or less saltish taste, when in reality the different perception is only attributable to the improved condition of the drinker's digestive organs. Bilious secretion is considerably increased, and altogether the circulation of the portal system promoted. If carefully selected, the springs are generally well tolerated by the digestive organs, and are recommended for abdominal plethora, dyspepsia, colic, and spasms of the stomach during menstruation; in fact, the same diseases are said to fall under the sway of Soden, as I have enumerated when treating of the neighbouring Homburg. It behoves us, therefore, to weigh the various properties of each before we fix our choice on either. In Soden, cutaneous perspiration is heightened. Should this be impeded by moist or cool weather, the water is less easily tolerated. The heightened arterial function produced by the Soden water affords a useful assistance in ganglionic torpidity, whilst it contra-indicates the spring in plethora, congestion to the brain or other vital organs, inflammation, fever, &c.

In the so-called 'molimina hæmorrhoidalia,' or hæmorrhoidal congestion, Soden exercises a very beneficial influence; also in hypochondriasis, hysteria, and in catamenial derangements. Chloride of sodium, the chief ingredient, after being received into the chyle and blood, is supposed to render valuable services by maintaining the liquidity of the albumen and fibrin, and thus preserving the composition and form of the blood globules. The importance of salt in digestion has been sufficiently enlarged upon on a former occasion. The *carbonic acid* is allowed free scope of action as an excitant and stimulant on the intestinal mucous membrane, and as a sedative and anti-spasmodic on the ganglionic nerves. The utility of iron is too well appreciated to need further remarks. We know its normal proportion in the blood is diminished whenever an excessive amount of secretion is formed, and therefore the blood-corpuscles would be deprived of their normal consistence without the addition of this element.

Tubercular diathesis is powerfully counteracted by Springs 1, 3, and 4, if used with whey, particularly in those cases complicated with anæmic condition. The extreme mildness of the climate here renders such a recommendation perfectly rational. Chronic pulmonary and laryngeal catarrhs are greatly benefited by this water.

The Springs 6 A, 6 B, 18, and 19, are chiefly employed in abdominal plethora, whilst 3, 4, and 1, are particularly recommended with whey or milk in thoracic weakness. In the case of weak digestive organs, 6 B agrees better than 6 A. If obstruction is present, an addition of No. 4 generally removes it.

The Springs 4, 5, 6, and 7, are also used for baths, which are brought to their appropriate temperature partly by the admixture of warm brine, and partly by hot steam. Kreuznach motherlye is always to be had at Soden, and often employed to increase the strength of the baths. Atonic nervous erethism of the female sex, especially in periods of progression or change, is greatly relieved by the curative influence of the climate, and this spot is often resorted to for that purpose alone. You have then to look upon Soden as upon a modified and milder Homburg, and will recommend it in such forms of digestive irregularities, abdominal plethora, hepatic and menstrual derangements, as require less powerful remedial interference. Again, if Homburg should be indicated by the state of the disease, whilst the general constitution of your patient exhibits tubercular diathesis and great inclination to bronchial catarrhs, or if the cutaneous function be torpidly performed, or apt to be checked by atmospheric changes, or by sympathetic internal disturbances, you will give the preference to Soden, not forgetting the sanative influence justly ascribed to its climate, which combines the invigorating, gently bracing action of higher positions with the protection of a sheltered valley, abundantly endowed with saline exhalations.

Wiesbaden.—We shall now resume our westerly course and travel to the neighbouring Wiesbaden. We make a slight detour for this purpose, but the speed of the railroad compensates for the circuitous passage marked on the map, and in an hour and a half we arrive at our place of destination. Wiesbaden lies on the southern declivity of the Taunus mountain, in a deep valley, at a distance of three leagues from Mentz (southward), and eight leagues from Frankfort (eastward). It is a flourishing town and the capital of the dukedom of Nassau, with upwards of 7000 inhabitants. Forty years ago, there were only 500 residents, so that the rapid increase of its population keeps pace with the considerable influx of visitors. Its latitude is 50°, and longitude east 8°. You perceive the Taunus rise on the other side of Homburg vor der Höhe, and extend towards the west as far as the Rhine, north of the Spa. Wiesbaden is one of the oldest German watering-places. It was well known to the Romans, who left many traces of their sojourn in the shape of coins and bath-ruins, with the inscription of the legion stationed there. The 'Mattiak' sources are mentioned by Pliny, who says, 'Sunt et Mattiaci in Germaniâ fontes calidi trans-Rhenum, quorum haustus triduo fervet.' The environs are charming. The 'Platte,' a ducal hunting castle, two leagues from Wiesbaden, at the foot of the 'Trompeter,' affords a most picturesque and extensive prospect of the surrounding landscape. A romantic semicircle of rising forests encloses the Spa on the north; in the south and west, fertile plains are intersected by the winding

Maine and Rhine, over which the antique Mainz rises with its churches and steeples. Behind this stands the lofty Donnersberg. A view of Mainz and of the picturesque Rhine villages is better obtained from the Geisberg, a promontory of the Taunus, a quarter of a league from Wiesbaden. Gentle fertile eminences on the south and east lead the visitor's eye to the extensive windings of the Rhine. You may judge of the mildness of the climate of this Spa from the fact, that with an altitude of 346 feet only, and the mountainous protection against north and east winds, many whose health requires a sojourn in the south during this season, choose it for a winter residence. The exhalations of the hot saline springs contribute in no small degree to deprive the winter of its severity. The vegetation is luxurious, and the abundant products of the soil sufficiently prove the appreciation of the climate by the vegetable kingdom, for almonds, sweet chestnuts, and many other southern fruits ripen here. But fresh drinking water is scarce, so that a stream had to be conducted into the town from the Platte. Historical documents show that the twenty-second Roman Legion, which helped in the destruction of Jerusalem, eighty years after Christ, was sent from Alexandria to Mainz, and fixed its quarters in Wiesbaden. Makrian, a king of the Alemannen, was unexpectedly attacked in the year 371, whilst using the baths of Wiesbaden, by Valentinian, but was fortunately rescued.

It was the chief seat of the Salish Franks, and inhabited for a long time by Charles and Otto the Great, who raised the place in 965 to the rank of a town. As a Spa, its reputation has chiefly spread since the sixteenth century. The beautiful walks in the environs offer sufficient inducement for exercise. From the Cursaal a road leads to the old château of Sonnenberg (half a league distant), through a pleasant valley and by the river side. The convent of Clarenthal is situated about half a league from the town, near the road to Schwalbach. About a quarter of a league further, in a smiling valley, the pheasant-house, with its views of the Rhine, invites the wanderer. The 'Walkmühle' is frequently visited for its alleys and walks.

Bilbrich, the ducal summer-residence on the Rhine, must not be left unseen. If you ascend the acclivity before Mosbach, you may pursue the Rhine upwards as far as the Melibokus, and downwards as far as Bingen, which would afford you a delightful panorama. The whole beautiful '*Rheingau*' may be embraced in this view.

The Cursaal of Wiesbaden is the place of re-union for the numerous health and pleasure seekers. It lies in a capacious plain, fronting the west. Several walks of plane-trees, limes, and acacias lead to the building, which bears the golden inscription :—' Fontibus Mattiacis, MDCCCX.'

At the principal frontage, a portico of colossal Ionic columns projects, intended for a protection to those who alight from their carriages. A colonnade with ornamented shops joins each side, and two pavilions form the wings. By an extensive hall we reach the principal saloon, which exhibits a length of 127 feet, and a breadth of 67 feet. On both sides a gallery is supported on marble Corinthian columns. In the niches of the sides are placed some magnificent statues in Carrara marble.

This beautiful structure is unfortunately defiled by the gaming-table, which is justly accused of undoing a great amount of the benefit conferred by the bountiful hand of Providence. To display their good effects, all the mineral waters require that the invalid should assist, as much as lies in his power, in a proper assimilation of the imbibed remedy, and in avoidance of any influence calculated to check the healing efforts of nature, bearing in mind the well-known proverb : ' Medicus curat, natura sanat.' Conceive, then, a valetudinarian, with deranged or stagnant abdominal circulation, seated, after a hurried breakfast, in a compressed position round the gaming-table for hours and hours, with depressing emotions, alternately stirring up his mind and lowering his nervous system, instead of walking in the beautiful green fields and meadows, throwing off all harassing thoughts and impressions, and encouraging the refreshing and invigorating ideas suggested by an undisturbed contemplation of the works of the Almighty. It is astonishing how these pernicious gaming-tables can be tolerated, when so much care is taken to guard against dietetic or climatic injuries. Surely at places so highly favoured as these Spas, such paltry attractions should be condemned, and these allurements left to less favoured regions. I must confess, it is with a feeling of deep sorrow and pain that I am compelled to admit the blot on many German Spas, at which a pursuit positively immoral and forbidden among the native inhabitants, is allowed with the poor excuse that it is permitted in other places, or, forsooth, that secret gambling would be resorted to with more injurious consequences. Let the government do its duty, and not remain blameable for the worldly and physical ruin of many a confiding visitor. No less than 30,000 guests are said to resort, on an average, annually to this unique Spa, which would be almost without reproach but for the evil which I have pointed out. Every year some improvement is effected in the town and its baths. The 'Cursaal,' with its magnificent rooms and its adjacent park-like walks, is greatly admired. The mountains consist of gross clay-slate, interspersed with quartz and mica. In the Rhine and Maine-basin it is united with conglomerations of silex, and several layers of clay, enclosing quartz, sand, and horn-stone; in the depth stratified lime is found, with many petrifactions. Basalt and strata of peat are remarked in the immediate neighbourhood of Wiesbaden, continuing as far as the bed of the Maine. The thermal springs owe their origin to volcanic causes. The sulphate of lime or chloride of magnesium present in the basaltic crust may have expelled the carbonic acid, for the formation of that quantity of Glauber or culinary salt which exists in the Wiesbaden water, and thus the production of carbonate of soda may have been prevented. The sources are distinguished by high temperature, abundant supply, and a considerable amount of solid ingredients. They supply no less than thirty-two bath-houses (nearly eight hundred bathing cabinets, and fourteen vapour-baths). The water is clear, transparent, with a slightly yellowish tint in some (as in the Adlerbrunnen). The smell slightly resembles that of slaked lime; the taste is saltish, somewhat resembling over-salted veal broth. The pellicle covering the surface of the water is chiefly composed of lime. The red-brownish substance deposited in the pipes consists of carbonate of lime, silicate of alumina, and oxide of iron, with some magnesium, strontium, and bromine. The specific gravity of the water is 1·006 (only No. 3 having 1·005). The temperature of the springs varies from 37½° to 57° Reaumur = 116° to 160° Fahrenheit.

The *Kochbrunnen* (literally, boiling well) constantly hisses and bubbles, emitting volumes of vapour, which gave rise to its present name; air-bubbles constantly rise from the depth and burst on the surface. Its enclosure forms an oblong quadrangle, with a depth of about five feet. It is surrounded by a circle of other bath-houses—on the north side by the 'Römer-bad,' 'weisse Ross,' 'weisse Schwan,' and the 'Engel;' on the opposite side by the 'Blume' and 'Rose;' at some greater distance the Englische Hof. Another open source is situated behind the bath-house (im Adler). The Schützenhof and gemeine Bürgerbad (common citizens' bath) possess a common source. The latter is mostly used by persons of the lower class. Indigent invalids find accommodation in the hospital founded by the Emperor Adolphus of Nassau. 34,000 cubic feet of water are supplied in twenty-four hours. The analysis of the *Kochbrunnen* shows 59½ grains of solid ingredients; temperature, 57° Reaumur = 160° Fahrenheit (2° less than Sprudel of Karlsb); carbonic acid about 5½ cubic inches, and nitrogen 0·08 cubic inches.

45·28	chloride of sodium.
0·30	„ potassium.
1·30	„ magnesium.
5·78	„ calcium.
0·18	carbonate of magnesia.
2·82	„ lime.
0·10	„ iron.
1·11	sulphate of soda.
0·42	sulphate of lime.
0·07	alumina.
0·37	silica.
0·06	bromide of magnesium, with 1000 of brom. of soda.
1·85	organic matter.

Total, 59·64 grains.

This great amount of constituents in such thorough combination, effected as it is by the high temperature, naturally exerts a powerfully curative action in many abnormal conditions, which yield to the influence of chloride of sodium with the other adjuvants. In small doses the water acts as a solvent and digestive remedy. In larger proportions, it is apt to cause diarrhœa, especially in persons whose cutaneous perspiration has been suppressed. When the peripheric function has been roused for some time, or a sediment formed in the urine, the increased alvine motions cease. In general, the hotter the water is for drinking, the less prone it is to cause diarrhœa. In some individuals obstruction is perceived at first; in fact, it is thought that some alvine disturbance takes place occasionally in the commencement of the course, till the remedy becomes properly absorbed and assimilated. By the well-known laws of antagonism, if you strengthen and regulate the nervous power of the skin, the sympathetic irritation of the intestinal mucous membrane gives way; whilst the springs with predominance of sulphates exert a lowering effect on the abdominal nervous plexus, and exhibit an increased action by being heated, you see the reverse taking place here; the former stimulation being still heightened by heat, the intestines may become over-stimulated, and refuse to act in consequence. The proper abdominal function will here be restored by the impregnation of the blood with the chlorides, which facilitate its movements, thus promoting circulation and removing those venous stagnations that impeded the normal secretions or peristaltic movements. Dyspepsia based on laxity and torpor of the muscular fibre is best counteracted by the sulphates; in persons with lymphatic or venous dyscrasy, the same ailment will be more properly subjected to the class at present under our consideration. As regards Karlsbad, the representative of the Spas with predominant sulphates, the principal effect is expected from drinking, a direct action is therefore sought. Here, the most general application is external; thus we seek the chief benefit in indirect processes, resulting from the peripheric stimulation as a natural reaction. Digestion may be really strengthened here, though appetite may improve more quickly at other Spas. The baths are taken in separate cabinets, after being carefully cooled to the required temperature. They are constructed of bricks, and covered by 'trass.'* The thermal water is allowed to fill the baths in the middle of the day, which are then ready for use next morning.

The diseases for the cure of which Wiesbaden enjoys the greatest reputation are, *chronic rheumatism* and *gout*, inveterate contractions, anchyloses, metastatic diseases arising in consequence of repelled cutaneous eruptions, abdominal venous or hæmorrhoidal congestion, &c. The Spa is *injurious* in great debility, fever, tendency to hæmorrhage, to abortion, scurvy, during menstruation, &c. At first, old rheumatic pains reappear during the course; this occurrence is considered favourable. In bathing, particular care is to be taken to prevent too high a temperature. Dangerous consequences are to be apprehended from the neglect of this precaution. The atmosphere of the bathing cabinet ought also to be as free as possible from hot vapours, which would partially counteract the beneficial action of the water. Dr. Wetzler mentions the instance of a young lady, in whom hæmoptysis appeared after a few lukewarm baths. When he instituted inquiries at the establishment in which this happened, he found the enclosed hot vapours to have been the cause of the mischief. Among the remedial means must be reckoned the *sinter-soap* introduced by Dr. Peez, and used for poultices and baths with advantage.

Without dwelling further on the special means employed for assisting the chief curative agents, I must inform you that Wiesbaden is recommended by many authorities as a winter residence, on account of the mildness of its climate, especially for those persons whose complaints require two successive seasons for a complete cure.

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* A sort of tufa, forming a very hard mortar, if mixed with lime; this combination becomes hardened by the water, and resists its action better than stone.

The hospital report of Dr. Haas, in ' Gräfe's Iahrbücher,' informs us that 691 patients were admitted in one year. About one-half were treated by the spa-water alone. One hundred and twenty-nine of these suffered from chronic rheumatism, forty-one from arthritic complaints, twenty-five from paralytic affections, &c. Of the first one hundred and twenty-nine, thirty were completely cured (that is, about one in four.) Out of the remaining ninety-nine cases, seventy-nine were improved. With reference to the forty-one arthritic cases, thirty-six were relieved. In most of these instances, little or no general reaction was exhibited; eight cases of rheumatic paralysis were relieved, and eight discharged without any improvement. Amongst these was one case of a paralysed tongue; one of paralysed lower extremities of three years' duration, after a miscarriage (aged 41); and another of paralysis and atrophy of the lower extremities, &c., induced by neglect of a luxation of the hip joint. In thirteen cases of chronic herpes, only one was discharged unrelieved. In all cases of pains after fractures, relief was experienced.

From the cases treated out of the hospital, he mentions that of a boy, of 14 years of age, formerly healthy, with the exception of a scrofulous habit. By frequent colds, his hearing became affected. Both auditory passages were somewhat narrowed, the tympanum in a more forward direction than usual. On the right side, the ticking of a watch was heard at the distance of two inches, but at the left only on closely applying it to the ear. By the removal of a large quantity of ear-wax, the evil was but slightly diminished. In catheterising the Eustachian tube, air could only be injected with great difficulty. The use of the baths during a fortnight, with local vapour-baths, and injections of thermal water, caused the tick of the same watch to be heard on the right side at a distance of twelve inches, and on the left at that of ten inches. Much mucus was discharged from the Eustachian tube by the injections, and the interior of the nose, formerly dry, had become moist.

He further adduces an instance of rheumatic paralysis of the urinary bladder of a female patient. Her physician reported—'The wife of the burgomaster S——, at H——, ætat. 39, had suffered for several years with violent articular rheumatism, particularly in the left upper thigh. Medical aid was not regularly resorted to. Derivatives were found very efficacious, but as soon as some relief ensued, they were abandoned. I several times urgently recommended Wiesbaden, but from pregnancy and other domestic causes, my advice had not been followed. Since last autumn, the rheumatic complaint entirely disappeared, but in its stead the abdomen became distended, menstruation ceased, strangury occurred, and was rapidly followed by incontinence of urine, and a discharge of dark gravel and mucus. Cantharides, ol. terebinth., &c., were employed in vain. Under these circumstances, I do not expect much from Wiesbaden, but *melius anceps remedium quam nullum.*'

After a fortnight's use of the baths, with douche on the sacral and lumbar regions, and a moderate internal use of the therma, she became so much improved, without febrile reaction or metaschematic processes, that she could hold the water for an hour at a time during the day, and incontinence became restricted to the night. After the second douche, the gravelly appearance diminished, and the urine became gradually clearer. No aperient action was perceived; but menstruation, which had been absent for fifteen months previously, now showed itself, and reappeared afterwards, but irregularly. Her general appearance and strength had likewise greatly improved during a four weeks' course. She now only complained of great thirst. The pains in the vesical region had entirely ceased.

Obermedicinal and Regierungsrath Dr. Franque relates the instance of a man of forty-two years of age, of robust constitution, who had lived to his present age free from dyscrasy and disease, notwithstanding a severe military service of fourteen years. By once sleeping on moist grass, the axillary glands, and afterwards the whole right arm, became swollen and painful. *Stiffness of the elbow-joint* remained, after the swelling had been removed by appropriate treatment. The flexor muscles of the arm were tense. On the upper-arm, above the internal condyles, two moderately deep ulcers discharged a watery purulent matter. The position of the elbow was half-bent. Diaphoretic treatment was first instituted in consequence of a cold, to which the patient was subjected during his journey to Wiesbaden. Subsequently a bath was ordered daily for half an hour, and douches of gradually increased strength on the affected limb. Complete cure of ulcers and anchylosis ensued during the course.

Another instance of rheumatic paralysis is recorded, occurring in a boy of eleven years of age, the child of poor but healthy parents. He fell into a pond; but instead of going home, he undressed, and exposed his clothes to the sun to dry, put them on after some time when still moist, and did not undress again till the evening. Dragging pains in the lower extremities, with rheumatic fever, soon occurred, but medical aid was not sought until the thirteenth day. The lower extremities were found paralysed, and so contracted in the knee-joints, that the soles were only 4½ inches removed from the nates. Anti-rheumatic remedies were resorted to, and succeeded in removing the fever, but paralysis and anchylosis remained. The baths and douches at Wiesbaden produced a complete cure. Other instances of rheumatic paralysis, complicated with repelled itch, are related as having experienced the beneficial effects of the Spa. I attach less value to the cases of icterus, abdominal plethora, &c., because other Spas would be more indicated; but let us content ourselves with the principal indication—*chronic rheumatism.* The reputation of the Spa for the cure of this disease is European, and the annual influx of valetudinarians is immense.

Those who doubt the efficacy of the mineral waters, or who ascribe the cures to the change of air, of diet, or to the physical properties alone, ought to compare for an instant our present Spa with Carlsbad. Wiesbaden, possessing one-third more of solid ingredients, and a few degrees less of thermometrical heat, ought to be considered more efficacious when used internally; whilst Carlsbad, with its minor contents and greater heat, seems to be primarily more intended for external application. But what do we find? That just the reverse universally takes place. Some potent difference must exist, to account for this apparent anomaly. Again, how widely different are the diseases cured or relieved at either, though the heat of the respective springs only differs by two degrees of Reaumur, whilst the baths are cooled to the same temperature in both before being used. I need not give guiding hints for selection between the two, because their indications differ too widely, according to experience. But you may have been reminded of another Spa while hearing the properties of Wiesbaden detailed. I allude to Wildbad, in Wurtemberg. I have shown that its greatest efficacy is exhibited in arthritic and rheumatic paralysis, and in such forms of gouty contractions as require absorption for their cure. You have arthritic affections there, closely resembling the rheumatic diseases curable here. You remember Wildbad to be one of the akratothermæ, that is, a spa only possessing a few grains of solid ingredients in sixteen ounces, where consequently no power is supposed to exist in the constituents. But if stubborn facts should show analogy in their action, and if on comparing their analyses, you should find both to possess the same constituents in predominance (chloride of sodium), with a proportionate amount of sulphate of soda and carbonate of lime (the chlorides of calcium and magnesium being absent in Wildbad), would it not strike you that some influence *must* be due to the constituents of Wildbad, beyond what is generally ascribed to that water? As I pointed out in my lecture on the Black Forest Spa, water of such high dilution must penetrate into the absorbent vessels, and introduce the dissolved ingredients more easily than denser waters. The amount of culinary salt absorbed from the richer Wiesbaden, possibly may not be greater than at Wildbad. The denser liquid finding more difficulty in entering the minutest lymphatic vessels, a great part of its efficacy must be ascribed here to the stimulating action of the warm brine on the peripheric nervous ends. By means of this powerful stimulation of the cutaneous system, the function of the exhaling dermic follicles must be considerably improved, and thus the cause of rheumatism energetically counteracted. The acknowledged advantage of warm baths in rheumatic diseases is here also unattended by the relaxation usually following the employment of these agents; the presence of the chlorides preventing such a result, by means of the reaction they induce. The assistance afforded by the internal use of Wiesbaden cannot be doubted, but its chief reputation having been created by the baths, we are justified in taking their therapeutic results into our more serious consideration. The analogy between the effects of the two named Spas is so great in some respects, that careful selection is necessary to decide between them. If you perceive the general nervous power to be in normal condition, but by a regulation of peripheric functions you hope to restore the equilibrium between the nervous and sero-fibrous systems, you will recommend the patient suffering with rheumatic paralysis to resort to Wiesbaden. If, however, the general nervous vitality be diminished—if age or debility does not allow hope of recovery from systemic reaction—if in the contracted or disabled joint, concrete exudations have been deposited, so that to return to a normal condition, not only the cutaneous but the lymphatic and nervous systems must be roused into great activity, you will recommend your patient to employ Wildbad. Though, as regards constituents, greater similarity exists between Homburg and Wiesbaden, their curative results vary too considerably for any difficulty to arise in discriminating between them; abdominal plethora and menstrual irregularities being the ailments chiefly cured at Homburg. You will observe what importance must be attached to the chemical character of the Spas, but at the same time their other inherent qualities must not be lost sight of.

Several experienced physicians reside at this fashionable Spa, as Drs. Von Franque, Vogler, Haas, Müller, Gergens, Fritze, Sandberger, Reuter, Menges, Ebhardt, &c.

LECTURE XIII.

WEILBACH.—BADEN.

GENTLEMEN,—From Wiesbaden we turn to the north-east and travel by the railroad as far as Flörsheim. From this town an omnibus conveys us in about ten minutes to the Theiokrene (cold sulphur spring) of *Weilbach*. The sulphur springs (*Theiopegae*, from ϑεῖον, sulphur, and πήγη, spring) are generally produced by the action of water on a sulphuret of sodium or potassium, or on sulphurous acid. Their chief ingredient is a combination of sulphur, which constantly evolves free sulphuretted hydrogen gas. The waters are clear or milky, resembling rotten eggs in their nauseous taste and smell. At Weilbach, the taste and smell are more like those of fresh eggs. By exposure to the atmosphere the waters are easily decomposed. If hot, they are called *Theiothermae* (from ϑεῖον, sulphur, and ϑερμὸς, hot), as Aachen (Aix-la-Chapelle) and Baden, near Vienna; if cold, *Theiokrenae* (from ϑεῖον, sulphur, and κρηνη, cold spring), as Eilsen, Nenndorf, Weilbach, &c. They all exert a beneficial influence on those cutaneous derangements which partially depend on a disordered action of the sero-fibrous system. Thus they powerfully counteract rheumatic, arthritic and herpetic diseases, by heightening the normal function of the skin, and by causing the excretion of effete sulphurous substances, which obstruct the action of secreting organs, acting offensively on the sentient nervous terminations, and causing neuralgia. The village of *Weilbach*, lat. 50°, long. east 8°, is situated on a fertile declivity of an alluvial mountain, almost midway between Frankfort and Menz, two leagues to the south of Höchst, one and a half from Hochheim, and half a league distant from the river Maine. The mineral spring rises about 1000 paces to the south-west of Weilbach, in a sloping field, connected with the village by a footpath. Towards the south the view is open, but to the east a steep hill rises, and affords from its summit a charming and extensive prospect. In a southerly direction lies the luxuriant Maine valley, with its capacious plain reaching to the Melibokus, the highest peak of the Bergstrasse. Your eye in glancing to the opposite shore of the Rhine is arrested by the vine-clad hills, on whose acclivities are situated Oppenheim and Nierstein. Towards the north, the Taunus peaks of Feldberg and Attking raise their lofty heads. In olden times the Weilbach spring was used by the inhabitants for cutaneous eruptions and ulcers, also as a domestic remedy in thoracic and gastric complaints. It was not until 1783 that the regency of Menz obtained a knowledge of the spring, and caused it to be examined and tested for diseases. The results proving satisfactory, the spring was enclosed. The water is forced into a marble urn and discharged by four pipes. It is transparent, and clear as crystal. The taste is sweetish at first, and afterwards bitter and saline, but not disagreeable. I found it myself very refreshing, and drank it with pleasure. It does not sparkle. Exposed for some time to the atmosphere, it deposits a yellowish-white precipitate of sulphur, carbonate of lime, and organic substance. Its temperature is 11° R. = 56$\frac{3}{4}$° F., specific gravity, 1·007. The supply during twenty-four hours is 2430 cubic feet. Analysis shows considerable variations at different periods. According to the latest, by Kastner, it contains—

2·94	cubic inches of sulphuretted hydrogen.
5·80	„ carbonic acid.
	Traces of nitrogen.

4·52	grains of carbonate of soda.
1·80	„ „ magnesia.
2·17	„ „ lime.
0·03	„ „ strontia.
0·35	sulphate of soda.
2·05	chloride of sodium.
1·00	„ magnesium.
0·36	silica.
0·08	organic extractive matter.
Total, 12·40	grains.

The spring was formerly called Faulborn (putrid well), and used in testing wine, vinegar, and brandy, for metallic salts, an evident proof of the abundance of sulphuretted hydrogen contained in it. The chemist Jung found in his analysis of 1830, 16¾ grains in 16 ounces; in 1834, 27¾ grains; in 1835, 30½ grains. The ingredients met with in the largest quantities were carbonate of soda and of magnesia, chloride of sodium and magnesium, and silica. The substance deposited in the marble urn adheres to the concave surface, and resembles a sea-green, flocculent kind of mud. The surface turned towards the water is covered with a pale yellowish powder, which is unctuous to the touch, and gives out a hepatic smell at first. When dried, pulverized in a wooden mortar, treated with rectified spirits of wine, filtered, and then evaporated, a peculiar resin is obtained, called *sulphur-resin.*

The water is generally well received by the digestive organs. The diuresis is invariably increased during the course. The matinal urine often appears clearer than usual, strongly acid, and contains neither carbonates nor sulphates. Alvine evacuations are rather retarded at first, but become gradually normal during the course. After some time, the fæces assume a greenish colour, chiefly caused by the presence of biliary matter and sulphuret of iron. The alvine retardation noticed above is never found to inconvenience the patients. If required, an aperient effect may generally be induced by repeated draughts of water taken at short intervals. Diarrhœa occasionally happens during cold, moist weather, or after sudden atmospheric changes, particularly in the beginning of the course. If inclination to relaxation of the bowels exists, diarrhœa follows, or is augmented, under the use of the water. This also frequently happens in hepatic hyperæmia. Appetite generally improves. Pressure and fulness in the pit of the stomach, with teasing flatulence, soon subside. Hæmorrhoidal swellings and blennorrhage of the anus disappear after the first eight or ten days; but Weilbach does not induce hæmorrhage from piles. Many have been entirely cured of this tendency without the least congestion to the brain or other vital organs in consequence.

Most of the invalids at Weilbach suffer from thoracic affections. The oppression and dry cough, characterizing incipient tuberculosis, diminish very soon; the frequency of the pulse decreases after a few days. Even hæmoptysis has been observed to cease under a careful use of small quantities of the water. In such forms of *incipient tubercular phthisis* as are connected with hæmorrhoidal dyscrasy, Weilbach stands pre-eminent by the striking cures it has annually effected. Diseases of the *larynx*, with or without hoarseness, particularly if caused by suppressed local perspirations of the feet, axilla, &c., or if based on hæmorrhoidal dyscrasy, are cured or greatly improved here.

In chlorotic laryngeal derangements, connected with catamenial irregularities, Weilbach would confer no benefit, but rather increase the evil. The same may be stated, if scrofula be the cause of the disorder. In certain chronic pulmonary diseases, the pulse is invariably found to abate, and the irritation of the bronchial mucous membrane to diminish. The oppression, dyspnœa, and dry cough of incipient phthisis, soon give way, unless there be anæmic condition or inflammatory irritation present. The number of respirations diminishes with the abatement of the pulse, enabling the patient to take deeper inhalations. The morbidly lessened vesicular respiratory murmur characterising this period becomes normal, whilst the cardiac sounds cease to be heard at the parts affected. All these beneficial changes occur more particularly in persons with hæmorrhoidal tendency or dyscrasy, who have generally a slender form, a dark complexion, prominent eyes, and with sclerotica of a bluish tint, dry skin, and whose whole appearance is leuco-phlegmatic. Bleeding from the nose, spitting of blood, and general orgasm have commonly marked their younger days. Such individuals particularly experience the curative effects of Weilbach if their thoracic organs are affected. Hoarseness through excessive use of mercurials yields to the water. In other tracheal and laryngeal complaints it is necessary to ascertain whether the uvula be reddened and lax, with an abundant venous development in the fauces, accompanied by cough and considerable secretion; for in chlorotic complaints of the same parts, with menstrual derangements, a troublesome sensation of dryness or burning, and a weakened rather than an actually hoarse voice, the evil would rather increase under the use of Weilbach. No benefit will result if scrofulous dyscrasia maintains or causes the affection. With regard to asthma, only such forms are improved as are connected with abdominal infarcta and obstruction. Perspiration is never caused by the water, but rather diminished in cases where an atonic state of the skin had induced profuse night-sweats. Bath eruption is rare. Chronic muscular or articular rheumatism is relieved, if accompanied by hæmorrhoidal congestion. Bodily strength and mental cheerfulness visibly increase. The water never causes vascular erethism; generally speaking, the female sex derive less benefit from Weilbach than the male. The *modus operandi* of the water is thought to be the following by Dr. Heinrich Roth, the highly intelligent physician of the Spa:—The water is mostly absorbed in the stomach with its sulphuretted hydrogen. The urinary excretion corresponds to the quantity of water taken. The absence of eructation and flatulence shows that the gas does not pass *through* the alimentary tube, but enters the circulation in unison with the water. On this account no increased evacuations ensue. If, however, in consequence of intestinal irritation, excessive doses, or impeded cutaneous function, diarrhœa should occur, the water ceases to be useful, for the patient becomes too much weakened, whilst the curative particles pass too rapidly through the alimentary tube to produce the metamorphic alterations required. The green excrements mentioned above contain a greater amount of biliary matter than usual, with sulphuret of iron as the colouring principle. If they are dissolved in water and treated with diluted hydrochloric acid, the green colouration disappears under evolution of sulphuretted hydrogen. After filtration the residue exhibits a decidedly bilious colour, and betrays the presence of iron. The same processes adopted with ordinary fæces of the same individual when removed from the influence of Weilbach water, elicited no change of colour, or evolution of hydrothionic acid, but only a trace of iron, and a less bilious colour of the residue. From this circumstance we must deduce an increased bilification. The sulphuret of iron can only have been conducted into the intestines along with the bile, the Weilbach water containing no iron. Being imbibed by the gastric capillary vessels, the water mingles with the blood of the portal vein. Sulphuretted hydrogen, which causes a green colour in ordinary blood by forming sulphuret of iron, combines here with those blood-corpuscles whose vitality has been diminished. Allowing their iron to combine with the sulphur of the gas introduced, they lose still more of their integrant constitution, and are the more fit for separation from their more vital neighbouring corpuscles. Thus by the use of the water a greater amount of material is furnished for the formation of bile. The transformation of the effete corpuscles into biliary matter is further promoted by the presence of carbonate of soda, which constitutes the prevailing solid ingredient. This salt is not discovered in the urine, whilst rain-water containing the same amount of carbonate of soda renders that excretion alkaline. Part of the soda required for the saturation of the choleic and stearic acids is supposed to be derived from the water. Under otherwise favourable circumstances, a more than proportionate quantity of bile must thus be produced. The older blood-corpuscles are naturally most exposed to this chemico-organic metamorphosis.

With anæmic persons, the green colouration of the excrements appears late or is not observed at all, the deficient state of the blood-elements admitting of a smaller abstraction of older corpuscles. If hæmorrhoidal swellings exist, the obstructed portal circulation causes vital retrogression of many corpuscles, and renders them more accessible to the chemical action of sulphuretted hydrogen. The characteristic colour of the evacuations appears sooner or later according to the more or less developed hæmorrhoids. After some time, this colour ceases, for the generation of new blood-corpuscles does not keep pace with the retrocession and transformation of the older ones. The accumulated material of effete corpuscles being now briskly removed, the normal intestinal function increases. The sallow and yellowish tint of such individuals, due to the incomplete transformation of these overloading materials, gives way to a clearer and healthier complexion. The emission of the sulphuretted hydrogen through the lungs and skin proves that it is less apt to attack those blood-corpuscles endowed with a great degree of vitality. Though the circumference of the abdomen decreases, signs of weakness, anæmia, and exhaustion, are never observed, notwithstanding the diminished quantity of blood. In chlorosis, however, and during recovery from acute diseases, the former weakness and anæmia would become more marked by the use of the water.

The improved appetite, perceptible immediately after drinking, is likewise ascribed to the more energetic sanguineous metamorphosis; but the liver itself must not be inflamed, enlarged, or otherwise diseased, or the Weilbach water will not confer its wonted benefit. It would not even be well received, but passing through the intestines it would induce diarrhœa. The characteristic colour of the stools would not appear, and generally the reaction which follows from increased hepatic function in an unaltered state of the tissue of the liver would be missed.

The morbid complexion of hæmorrhoidal patients arises, as already alluded to, from an incomplete elaboration of the blood-corpuscles by the ordinary channel. Too numerous to transude through the cutaneous pores, they impart to the skin that peculiar characteristic tint. The formation of blood-corpuscles is shown to be particularly active in hæmorrhoidal individuals, by their generally bearing hæmorrhages without becoming weakened or anæmic. Bleeding at the nose, flowing piles, excessive catamenia, &c., do not seem to induce paucity of blood with them. This may proceed from the insufficient transformation of old blood-corpuscles in the liver. Regeneration of new corpuscles taking place as usual, the blood becomes overcharged with corpuscles, and general circulation is somewhat impeded. The intestinal and other organs perform, therefore, their functions with less ease; hence dyspepsia, flatulence, distention of the abdomen, languor, headache, &c., inconvenience the patient till the efforts of nature relieve the circulating organs of this surplus of older corpuscles by hæmorrhage. The continuation of the same causes will, after some time, reproduce the same necessity. Weilbach is therefore eminently useful by counteracting the cause of hæmorrhoidal congestion. Excessive catamenia are diminished, and hæmorrhoidal tendency retrogrades; even flow of piles decreases and ceases entirely by the use of the water, the want of such a reparatory discharge having been obviated.

From the same reason—viz., the rapid consumption of the old blood-corpuscles,—Weilbach is useless or injurious in chlorosis, amenorrhœa, and anæmia from metrorrhage; in recovery from typhus or other severe diseases, &c.

The course of the blood becoming freer in the hæmorrhoidal vessels, the vascular absorbents are enabled to imbibe more of the liquid intestinal contents, leaving a smaller quantum for fæcal excretion. On this account, the evacuations are rather diminished at first, but without any of the ordinary sensations or inconveniences connected with obstruction. The increased absorption of liquid alimentary matter forms some compensation for the heightened elimination of blood-corpuscles. After some time, the increased formation of bile will end in a greater intestinal stimulation, and the alvine action will thus become regulated. The increased separation of blood-globules from the portal system must extend its influence to other organs; this gradual and steady liberation of obstructing particles enabling that system to afford greater assistance in general circulation, and to receive more blood than before. The hyperæmic or congested state of the pulmonary tissue diminishes, therefore, under the use of Weilbach. Respiration becomes freer, oppression of the chest, dry cough, &c., decrease perceptibly. Hæmoptysis often ceases, the pulse becomes slower, night-perspirations gradually vanish, &c.

Weilbach thus acts as a sort of chemico-vital derivative, becoming powerless whenever the laryngeal or bronchial irritation proceeds from other causes than hæmorrhoidal congestion, as in already deposited tubercles, in chronic inflammation of one of these organs, &c. Pulmonary irritation, from the causes already described, finds more often relief here than laryngeal or tracheal. The advantage derived from Weilbach in pulmonary complaints would be diminished or destroyed by large quantities of the water. This must be attributed to the circumstance of the excessive amount of sulphuretted hydrogen not being absorbed in the portal system, producing irritation in the blood-vessels and ultimately in the lungs, from which it must be exhaled. Whilst in acute diseases detraction of blood unfortunately removes newly formed as well as effete blood-corpuscles, and following weakness is to be dreaded, the derivative and revulsive action of Weilbach offers a different character. Chronic bronchial catarrh, incipient phthisis, spitting of blood, congestion to the head, based on hæmorrhoidal dyscrasia, gradually give way here, because the organs of respiration become relieved of a great overcharge of the blood without loss to the system of efficient vital and nutrient corpuscles. Besides the derivation, the composition of the blood becomes more normal, and thus forms a better stimulus and regenerating agent for the various organs, which in their turn are more fitted for the performance of their regular functions, and thus improvement of health will continue even after the action of the water has ceased. If favourable phenomena do not make their appearance within a few weeks, no cure can be expected. The utility of Weilbach in chronic poisoning by lead or mercury is apparent.

Baths are often employed as an auxiliary to the internal use of the water. Inhalation of the atmosphere surrounding the well has afforded no striking results. The hæmorrhoidal disease is frequently cured here, in contradistinction to many other spas, where the flow of repressed piles is promoted. Chronic rheumatism and cutaneous eruption, accompanied by hæmorrhoids, are likewise often cured or relieved here. The same may be said of urinary or sexual diseases resulting from hæmorrhoidal obstruction. The water must be drunk in small draughts, or the gas would not be so rapidly absorbed, and, consequently, would cause distention of the abdomen and irritation of the lungs.

In filling the glass, certain precautions are necessary—viz., the water should run down the sides of the glass, and the latter should be kept as close to the spout as possible, for if the glass be held at some distance, and the water allowed to fall with force into the centre, a great quantity of atmospheric air is drawn in with it, whilst the violent agitation causes the inherent sulphuretted hydrogen and carbonic acid gases to escape too soon. From two to six glasses (of six or seven ounces each) are taken in the morning. Sometimes before dinner a smaller dose is repeated.

The diet must be very temperate at first, but more nourishing afterwards. Care must be taken that the liver and intestines be not taxed too much by fatty or indigestible food, or spirituous liquors.

You may, perhaps, ask whether we can expect such important results from so small an amount of sulphuretted hydrogen—viz., about 2½ cubic inches in a pint of water? and whether we ought to attribute the same action to all sulphurous springs? The answer to this is, that the proportion of the gas is extremely large here, surpassing in this respect all other theiothermæ of Germany; Aix-la-Chapelle, the most celebrated, having only 0·13 cubic inches, Baden, near Vienna, 0·70, Eilsen 2·01, Nenndorf (Quelle unter dem Gewölbe) 1·21, Weilbach 2.64.

Although the same gas stamps their general character, the diseases for which they should be recommended are widely different. Sulphurous springs are generally set down as most useful in chronic rheumatisms and cutaneous eruptions, and it might be imagined that we have only to choose between a hot and cold spring. If you visit Aix-la-Chapelle, for instance, you will find most of the valetudinarians there to be suffering from affections of the sero-fibrous or cutaneous system, and in vain will you look for patients who seek relief from pulmonary or laryngeal complaints. But here you will notice the reverse. The Spa, however, is very little known, and is not appreciated as it deserves to be. When I visited the chief spas for the first time, it was my intention to pass by Weilbach, which cannot be compared for reputation with the spas previously mentioned. I happened to stay at the post hotel at Kreuznach. When just on the point of starting, the head-waiter, who heard that I intended to visit Soden, asked me whether I would not pay a visit to Weilbach, and said I should perhaps feel interested in seeing his principal, who had laboured for several years with spitting of blood, and such an exhausting cough, that his friends laughed at him, when, after a fruitless resort to Ems (which enjoys such a European reputation in pulmonary diseases), he rode to Weilbach at the recommendation of some acquaintance; but he persisted, and subsequently found there a complete cure. The landlord confirmed the statement of his waiter, and appeared to me then hale and hearty. The basis of his pulmonary disorder lay in hæmorrhoidal dyscrasy, and as soon as he presented himself to Dr. Roth, that physician informed him that his case was particularly fitted for Weilbach, as it afterwards proved. I at once determined to alter my route, and to examine a remedial agent which had afforded such striking results.

Last year I had another opportunity of testing the efficacy of the Spa. A German merchant, then residing in London, 42 years of age, and a native of Nassau, resided from his 20th to his 27th year in Holland (Rotterdam and Amsterdam). When in that country, easterly winds caused him pain in the chest, which, however, generally passed off without medical aid. When a boy, he was in the habit of leaning with the left side of his chest to the writing-desk. His left breast became depressed in so conspicuous a manner as to make him free from conscription. His mother had died of apoplexy in her 66th year, his father of hydrothorax at the age of 76. One sister had suffered from influenza when 24 years of age. Hoarseness and cough continued, and subsequently consumption carried her off in her 32nd year. The gentleman in question was well while in London, with the exception of *erythema frontis,* which for several years appeared every autumn, inconveniencing him till the commencement of spring.

In the beginning of 1849, very troublesome furuncles kept him confined for several weeks. Cough and hoarseness followed this eruption, with oppression of the chest, but without pain in breathing. He felt occasionally giddy and very weak, though his appearance did not indicate phthisical tendency, but rather gave the impression of a healthy constitution. Some years ago, he had suffered with piles, and now he has occasional signs of hæmorrhoidal congestion. He left London last summer for Weilbach, and returned completely cured. This winter his usual eruption of the forehead has not appeared (though a little more redness may be perceived), and the state of his laryngeal and pulmonary organs is perfectly normal. A somewhat less metallic sound may be remarked in his voice; but he complains of no cough, oppression, hoarseness, or giddiness. The furuncles and ecthymata which he dreaded again this year have spared him, so that no doubt is left that he owes his restored health to the agency of Weilbach.

Baden, near Vienna.—For the consideration of the next Spa, Gentlemen, I shall request you to retrace your steps to *Vienna,* the Austrian capital, and thence proceed southward by railroad to Baden, which distance is performed in an hour. Baden was known to the Romans under the name of '*Pannonian Baths.*' The history of this now beautiful town is full of interest. How often were the vineyards and orchards destroyed, the houses burnt, the inhabitants plundered and murdered, now by the Turks, then by the Huns, now by the Turks again, who added to their other cruelties the pastime of burning those treasures which they could not carry off with them. Then again French armies laid contributions on the exhausted treasury of the inoffensive town. Scarcely was one injury repaired when another befel them in the shape of extensive conflagrations. In reading these details, one cannot help feeling thankful for the advantages and blessings of our advanced civilization, compared with that of the dark middle ages, where physical force was allowed to trample under its feet the most sacred rights of humanity and justice.

The discovery of the Spa is popularly ascribed to the following circumstance :—At some very remote period, the dogs of a neighbouring nobleman were missed for a few hours every day in the adjoining forest. They were known to be affected with a kind of lepra, and when carefully watched and followed by some huntsmen, they were found to seek some warm springs in which they bathed for some time, and then returned to their master. Their eruption having afterwards been found to be cured, the nobleman had the surrounding trees cut down and the source enclosed for the relief of human ailments.

Baden is situated in lat. 48°, and long. 15° east, on the Schwöchat,* four miles to the south-east of Vienna, at the foot of the *Wienerwald*, 638 feet above the level of the sea, and in a very charming country. The Cethic mountains surround the place from the north and west, whilst to the south-east an extensive open plain stretches as far as the frontier of Hungary. To this position we must ascribe the frequent atmospheric changes to which the place is occasionally subject, amounting sometimes to 15° R.=34° F. in one day. The environs of Baden are very fertile ; wine, fruits, and agricultural products are alike found here in abundance. Baden has about 5000 inhabitants, and attracts numerous visitors, tempted to a sojourn by the neighbouring 'Kaiser-Stadt,' besides the crowd of valetudinarians that annually resort thither. It belongs to the class of Theiothermæ (warm sulphurous springs), and appropriately follows as a contrast to the last cold sulphur-spring which we have examined.

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* The Schwöchat rises in the south-west, proceeds towards the east, bounding the Spa, and then takes a northern direction till it joins the Danube, near Kaiser-ebersdorf.

A very great advantage of the Baden water lies in the circumstance that neither heating nor cooling is required to fit it for bathing. The atmosphere of the place is so impregnated with sulphurous exhalations, that metallic objects quickly become tarnished and blackened. The surrounding mountains consist of stratified limestone, slate, and gypsum, and are interspersed with sulphur-pyrites, stalactites, mineral coal, and some curious petrifactions. The climate is generally dry and healthy, with the exception above alluded to.

The whole valley offers a complex of beautiful walks and parks, with rocks and forests beyond. The Alexandrowiczsche Anlage, approached by gardens and vineyards, leads us to the steep rocks behind the Schönfeldish houses. The Carpathian mountains bound the plain on the south-east. The Langische Anlage, to the south of the Calvarienberg, abounds in rocks ornamented with shrubs, luxuriant foliage winding along the walks, with turf-seats interspersed. The Weilburg stands in its grounds, a memorial of antiquity. The '*Helenen-thal*' (valley) extends from Weikersdorf to Heiligenkreuz, and is replete with charming spots and shady walks. The Antonsgrotte, Antonsbrücke (bridge), Krainerhütten, &c., are all objects of great attraction. I will merely add the account of a place, situated a league to the south of Baden—viz., *Vöslau,* at the eastern declivity of the Vöslauer *Lindkogel,* remarkable for its swimming bath and beautiful garden. A small brook existed formerly here. The strong evolution of nitrogen gas was so striking, that the water was analysed, and a spring was thought to exist in the bed of the river. In 1825, the brook was diverted from its course, and digging for the source was commenced. At the depth of four fathoms the ground sank into a cavern, out of which a stream of water issued in a thick column, and with considerable hissing. The water was sometimes turbid, with a temperature of 25° R., at others, clear, of a temperature of 23° R. At the time of this observation, the atmospheric temperature was 10° R. below zero. Stones were hurled upwards, and other signs of great commotion exhibited. The complaint of the surrounding peasants, of the neighbouring wells becoming dry, necessitated an inclosure of the source in 1825. A large pond was then dug out, and provided with all appliances for a swimming-school. A convenient bath-house, with four bathing cabinets, was erected near it. The spring arises out of a mountain composed of dolomite, and indicating a distant volcanic origin. The water is clear, transparent, inodorous, and insipid—temperature, 19° R. = 75° F.; specific gravity, 1·0005. It contains scarcely 3½ grains of mineral ingredients—consisting of carbonate of lime, sulphate of lime, of magnesia, chloride of sodium, of calcium, and silica, besides carbonic acid and nitrogen. This swimming-bath forms an excellent preparation for weakly or irritable persons before the employment of the warmer thermæ of Baden. Not a trace of sulphuretted hydrogen is found in this water, though it seems to derive its heat from the same subterranean process which raises the temperature of the Baden water.

The temperature of the springs in Baden varies from 29° R. to 22° R. (98° to 81° F.)—viz., in Josephsbad the source is 29° R. (the bath 28·6°), Frauenbad, 28·9° (bath 28·4°), Frauenbäder, Stundenbäder, 28° to 27°, Carolinenbad, 28°, Römerquelle, 27·9°, Halbbäder, 27·2°, Theresienbader, Nos. 1 to 6, 26° to 27°, Armenbad, 25·8°, Mariazellerbad, 22·9°, Peregrinibad, 22·2°. No less than thirty-three springs exist in or near the town, of which I have only enumerated the principal ones. They contain 12½ grains of solid and 1½ cubic inches of gaseous constituents in a pint of water—viz.,

3·20	sulphate of lime.
1·99	,, soda.
1·36	,, magnesia.
1·34	chloride of sodium.
0·36	,, magnesium.
1·75	carbonate of magnesia.
1·80	,, lime.
0·07	,, lithia.
0·73	animalo-vegetable substance.
——	Traces of phosphate of lime.
Total 12·16	grains.

GASEOUS CONSTITUENTS.

0·7 cubic inches of sulphuretted hydrogen.
0·5 „ „ carbonic acid.
0·3 „ „ nitrogen.
—
1·5

The amount of solid ingredients you perceive to be equal to that of Weilbach, but their quality is widely different. The chief constituent of Weilbach is carbonate of soda ($4\frac{1}{2}$ grains), of which no trace is found in Baden. Sulphate of lime, the principal constituent of Baden (3·2 gr.), does not exist in Weilbach; carbonate of magnesia and lime, and chloride of sodium, are found in rather smaller proportions at Baden; sulphate of magnesia is absent in Weilbach; sulphate of soda only $\frac{1}{3}$ of a grain; thus we have sulphates predominating in Baden and carbonates in Weilbach. As regards the volatile ingredients, Weilbach has three times the amount of sulphuretted hydrogen—viz., $2\frac{1}{2}$ cubic inches to 7-10ths here, and ten times as much carbonic acid, 5 cubic inches to $\frac{1}{2}$; but Weilbach possesses no nitrogen. Besides, you are justified in attributing to the sulphuretted hydrogen somewhat more power than its proportion to Weilbach would seem to warrant, on account of its connexion here with thermal water, by which its efficacy and facility of penetration are promoted. The therapeutical results of either Spa will be found to coincide with their chemical and physical characteristics. The water of Baden is clear and transparent when drawn, but becomes rather milky when exposed for some time to the air or light. Its taste and smell are strongly sulphurous; the springs all furnish an abundant supply; the specific gravity of the water is 1·004. The yellowish crystals deposited on the sides of the springs are known as Badner salt. The *bath-mud*, the result of precipitation out of water, is to be distinguished from this.

The Josephsbad is a round temple-like building, ornamented with Ionic columns. About sixty persons may bathe in the capacious quadrangular baignoire. It is situated in the Josephsplatz, near the Anger. The *Frauen-*

bad is situated to the east of the former, at the end of the Frauengasse—its baignoire holds ninety persons. The same source supplies four so called: 'Frauenstundenbäder,' (women's hour-baths), containing space for one or two bathers only. The *Carolinenbad,* formerly called 'external women's bath,' forms the southern part of the same building; fifty persons find bathing room in its baignoire. The *Engelburgbäder,* lying on the other side of the Schwöchat, were formerly only used as foot-baths, but are now provided with accommodation for douche, shower, and full baths. The temperature of the baths is $27\frac{1}{2}°$ R.—source $28\frac{1}{2}°$. The *Sauerbad* (so named, not from any acid properties, but from its former possessor) is likewise situated on the other side of the Schwöchat, and was newly enclosed in 1821, and provided with an elegant bathing saloon. The temperature of the baths is $27\frac{1}{2}°$ R. The *Romerquelle* (Roman's source), commonly called the 'Ursprung,' arises at the foot of the *Calvarienberg,* with such abundance, that it is able to supply the 'Halbbäder,' 'Theresienbader,' &c. By a subterranean passage of about forty-five yards in length, you reach a capacious cavern, in which a caldron two fathoms deep is constantly filled with the bubbling water from below. It is enclosed by wooden balusters. Formerly the water was drawn here, and carried along the passage to the exterior for use. Now this objectionable mode has been done away with by the erection of a 'Trinkbrunnen' (drinking-well,) which receives the spring out of porcelain pipes, and discharges it into a marble basin. A stop-cock is fitted to the spout, to regulate the supply. In the above passage, artificial bath-mud is prepared, and arrangements adapted for the use of a vapour bath. The temperature of the source is $27\frac{3}{4}°$ R. $= 94\frac{3}{4}°$ F.

At the sides and ceiling, the salt crystals, formed by sublimation, are sometimes re-dissolved by the exhaling vapours, and fall down as 'acid drops,' destructive of the colour and material of clothes. The salt is dry, yellowish white, crystallized in fascicular needles, easily friable, and interspersed with minute veins of sulphur, from which they may be separated by solution in water. Taste and reaction of the salt are acid: it loses forty-six per cent. by being heated, and contains in one hundred parts—

37·70	sulphuric acid.
8.00	alumina.
7·34	protoxide of iron.
46·00	water of crystallization.
0·88	sulphur, and other admixtures.
0·08	loss.
100	

This shows a considerable excess of sulphuric acid (for only 18·73 parts are required to saturate the alumina, and only 8·37 for the neutralization of the iron, leaving an excess of about ten parts). Though this phenomenon is not rare in volcanic craters, it is of less frequent occurrence in the thermæ. The sulphuretted hydrogen rapidly issuing in bubbles out of the source, abandons part of its hydrogen to the oxygen of the air for the formation of water, whilst its sulphur, under the influence of heat, partially precipitates and partially attracts the disposable amount of atmospheric oxygen for the formation of sulphuric acid. These acid vapours act then on the ferruginous and argillaceous walls, and dissolve those particles met with in analysis.

The *Herzogsbad* possesses the most capacious baignoire, conveniently holding 150 persons. It receives its water by leaden pipes, from the Römerquelle—temperature, $27\frac{3}{4}$° R. $=94\frac{3}{4}$° F.

The *Antonibad* (temperature, 27° R. = 93° F.) is situated near the latter, and has the same origin.

The Military-bath, Franzensbad, Leopoldsbäder, &c., are sometimes chosen on account of their lower temperature. Vapour, douche, rain and shower-baths are also provided in the various establishments. The ascending douche is administered in appropriate cases.

But a distinguishing feature of this Spa consists in the newly-erected *sulphurous swimming-baths*, one for ladies and one for the male sex, supplied by springs of 22° R., and cooled down by the extensive surface to 19° R. = about

75° F., by the time it is used. The greater number of swimmers I noticed at the time of my visit were youthful patients, and the advantages resulting from this combination of muscular exercise with the free imbibition of this medicinal liquid, are said to be very great. Indeed, considering the composition and properties of the water, it would be surprising to find it otherwise. Children affected with rheumatic tendency, with cutaneous acrimony, with weakly-developed thoracic organs, derive great benefit from them; and I doubt not that many a morbid diathesis will be checked and made to retrograde by the early use of these baths. The great value of preventives is well expressed in the proverb—that not he who operates best is the greatest surgeon, but he who is best able to avoid by his skill, the necessity for operations. Great praise must be due to a physician whose keen sight detects the signs of incipient derangement, and by judicious measures renders his medical skill unnecessary.

In justice to our profession, however, it must be stated, that the fault of less frequent prevention of disease, lies more with the public than with ourselves; for our opinion is generally not sought before marked or aggravated disease has excited alarm. And here we must admire the wisdom of Providence in giving to our species a sense of *pain*—at the same time an evil and a blessing. Thousands would unsuspectingly be brought to the door of irreparable destruction, if the all-wise Providence did not send a timely monitor in the shape of pain. How admirably is our Creator's goodness again displayed in this respect; for where the disease is incurable, and therefore warning less required, you generally find a diminished degree of pain. In consumption, for instance, the more developed, the more inaccessible to remedial measures, the less pain is experienced. Confirmed dropsy, diabetes, tetanus, and many other fatal diseases, might also be cited as instances. But to return to our Spa.

Besides full baths, half, foot, and hand baths are often exclusively employed at Baden in certain cases. This spa in general is recommended in recovery from weakening diseases (where Weilbach would be injurious), in diminished sensibility or irritability, chronic rheumatism, paralytic affections, swellings of the liver or spleen, in certain chronic eruptions, whenever the function of the skin has been repressed or morbidly altered, in mucosity and catarrhal irritation of lungs or intestines, hydrargyrosis, and chronic poisoning by lead. 'The swimming-baths have shown themselves especially *curative* in articular contractions and slight curvatures of the spine. This Spa is *contra-indicated* in plethora, active congestion, inflammation, or inflammatory tendency, fever, confirmed phthisis,' &c.

The *Badeschlamm* (bath-mud) chiefly consists of argilla, wetted with the water of the Ursprung.

Dr. Rollet related to me the case of a major in the army, who, in consequence of recent injuries, was suffering from painful and stiff joints, which necessitated the use of crutches. This gentleman applied to him with the intention of using the baths. But the doctor considered the symptoms too acute for the Spa; he therefore ordered mud-poultices to be applied over night for a week, at the end of which time the pain was so much diminished, that he was enabled to use the baths, and left the place cured after three weeks.

In chronic *emphysema*, resulting from neglected pulmonary catarrh, Baden is asserted to be peculiarly beneficial. Dr. Habel recommends Baden in chronic gout, but neither vascular irritability nor great nervous sensibility must be present. The Baden Spa is particularly adapted to that form of gout caused by depressing influences, and exhibiting more the character of arthritic remains; also in scrofula, the prevalence of acidity, the deficient chylification and lymphatic absorption, are corrected by the Spa stimulating the peripheric extremities of the blood-vessels and nerves. Secretions are promoted, and morbid products absorbed and removed. Drinking must be combined with the external use for this disease. In cases of children who refuse to drink, clysters of the water must be substituted. For psora and herpes the baths are greatly extolled.

In idiopathic paralysis no advantage is derived from this

Spa. The benefit in syphilis is restricted to the diagnostic value in cases of affections bearing a doubtful psoric, hydrargyrous, or syphilitic character. The two former are relieved or cured by the Spa; the latter would be rather aggravated. In complication of syphilis with hydrargyrosis the latter disease is removed, and the former simplified, so as to be amenable to ordinary treatment. You perceive, then, Gentlemen, that Baden should be selected, when the functions of the cutaneous and fibrous system have to be regulated, when absorption has to be promoted, when rheumatic, arthritic, or psoric dyscrasy has to be counteracted, whilst heightened function of the bile is only enumerated as a secondary or occasional result. So far from its serving as a derivative or revulsive, it must never be employed where inflammation, or even congestion, exists. External employment is mostly resorted to. If you compare these peculiarities with its brother theiopege, Weilbach, you will find the Nassau Spa almost diametrically opposite. Weilbach is chiefly employed internally. The principal diseases there are hæmorrhoids and pulmonary or laryngeal affections, dependent on hæmorrhoidal dyscrasy. The marked activity of the portal and biliary systems imparts to the Spa a derivative influence upon vital organs somewhat analogous to sanguineous depletion. Menstruation and piles are not promoted, but rather abridged. Exhausted persons become weaker still. Convalescence is prolonged after atonic nervous diseases, or depressing hæmorrhages. Keeping these brief hints in view, and paying special attention to the remote cause through which the disease is kept up, you will require no deep investigation to choose between the one or the other of the same class.

LECTURE XIV.

KREUZNACH.—ADELHEIDSQUELLE.

GENTLEMEN,—We pursue our journey, after the deviation made for the sake of contrasting the Weilbach and Baden Spas, and return westward towards *Biberich.* Here we exchange our confined position in the railroad carriage for the Rhine steamer, which carries us rapidly towards the western curve, on which is situated *Bingen* (about one hour and a half). At Bingen we leave the Rhine with all its romantic associations, and while most of our fellow-passengers speed onwards to the north, approaching the mouth of father Rhine, I invite you to accompany me in an opposite direction, and to take your seats in a modest 'stellwagen' (a kind of omnibus) which awaits our arrival to convey us in two hours to the Spa. *Kreuznach* is situated on the *Nahe,* which rises in the west beyond the Hundsrück mountain, and, after a serpentine eastern course amongst the hills, turns northward, and emerging from rocks, descends into a smiling valley full of picturesque spots, intersects the town of Kreuznach, and passes northwards through fertile fields and green meadows to Bingen, where it pours its stream into the mighty Rhine. The town, containing about 8000 inhabitants, belongs to the Grand-Duchy of Hesse, but is under Prussian dominion. Its latitude is 50°, its eastern longitude 8°; it is three leagues distant from Bingen, eight from Mentz, and ten from Wiesbaden; its height above the level of the sea is only 285 feet. The two parts, into which the town is divided by the river, are unequal. That on the left bank is inclosed by the Schlossberg and other hills, while the country of the right bank is of a more level character. On both sides of the connecting bridge, green islets emerge out of the Nahe, the upper ones giving birth to the mineral springs at an altitude of 308 feet. Charming gardens, well-cultivated vineyards, rich pasture, and cornfields, amply testify to the fertile condition of the soil.

The ruins of the so-called 'Heidenmauer' (pagans' wall), on the right of the Nahe, prove that the Romans reached the place in their insatiable lust of conquest, and endeavoured to maintain the Rhine boundary by a fortress. Many of the old castles and towers have disappeared; the ancient fortress of the Counts of Sponheim has remained in ruins since its destruction by the French. Vineyards and shady walks cover the sides of the mountain, over which a fortified castle domineered at the time of the thirty years' war. The excise buildings now occupy the place in the 'Hohe Strasse,' where formerly the mansion of the Pfalzgraves of Simmern stood. A capacious 'Casino' was lately built, with tasteful walks, before the Binger gate. The streets of the town itself are generally narrow; the Nahe bridge, connecting the two parts of the town, conducts you over the two arms of the river and its islets by seven arches; it is said to date from the fourteenth century; the houses standing upon it give it rather a curious appearance. As a curative agent, this Spa has only been known for about thirty years.

The *Elisabethbrunnen,* the most celebrated of Kreuznach's springs, rises on the southern extremity of the Nahe islet. About ten feet under the 'dam-earth' the source issues from a bore hole, penetrating into porphyry to the depth of thirty-six feet; the enclosing basin guards against the influx of atmospheric water; a strong dam of stone surrounds the spring on three sides, and serves, by its colossal proportions, to prevent overflow, or ice from disturbing the spring. From the platform you enjoy a pleasant prospect of the river above and below the town. To the west, the vine-clad sides of the Schlossberg greet your view, and southward are the hills from which the salt springs arise. The iron balustrade combines elegance with strength. About 1600 cubic feet of water are supplied in twenty-four hours; a pipe communicates with the basin, and discharges the water in an uninterrupted stream; a pump drives it into the bathing-house, about one hundred yards distant, at times when the spring is not used for drinking.

A second spring of great abundance rises in the bed of the river, between the Elisenbrunnen and the left bank of the Nahe. At a depth of ten feet it issues out of numerous fissures of porphyry; a basin and air-tight covering of brick-work guard it from admixture with the Nahe water, which passes over it. By subterranean iron pipes the water is conducted into a reservoir near the Elisenbrunn for baths. The daily supply amounts to 3000 cubic feet. Half a century has not elapsed yet since this source was first discovered. Encouraged by 'Schulrath' Zeller, Wilhelmi, the proprietor of a tavern at the place, persevered with great constancy in boring trials, although the existence of a saline spring at the point of the islet was represented as highly improbable, the porphyry disappearing here under the red sandstone. His exertions, however, were unceasing—his excited expectations of the day were confirmed by phantoms and treasures in prospective in nightly dreams, and his efforts were at last crowned with success, in the year 1832, by the discovery of the now celebrated Elisabethbrunnen. When the upper layer of sandstone had been penetrated, the porphyry was perceived; a depth of three feet only bored into the latter, caused a stream of the expected brine to issue forth with violence. A preliminary examination proved its analogy with the springs of the neighbouring salt valley. In 1834 it was enclosed, and the environs cultivated in a manner worthy of its rising reputation.

The islet was connected with the high road of the 'salinen' valley by a convenient walk, shaded by a double row of lime-trees. A grand 'Kurhaus' was built, with capacious saloons, refreshment-rooms, bathing-cabinets, and apartments for visitors. This establishment was inaugurated only nine years ago. Another spring has since been discovered between the Elisenbrunnen and the salt-works near the Oranienhof, and is frequently employed for bathing.

The porphyry rocks of the 'Haart' mountain on the left, and of the 'Gans' on the right bank, form a narrow valley, intersected by the Nahe, south of the town, and give rise to the saline springs of the *Theodorshalle* and *Münster am Stein,* north and south-west, and of the *Carlshalle,* to the east. Their abundance is such, that the Carlshalle and Theodorshalle alone afford an annual supply of three million cubic feet of brine. The springs of the Theodorshalle, to the number of eight, arise from various depths. The chief well is situated near the boiling-house, and used for drinking. In its immediate neighbourhood, one of the largest 'graduation-works' reaches as far as the Nahe, its covered passage serving as a convenient walk in rainy weather. If you cross the Nahe, you perceive, on the right bank, near the bridge, the well of the Carlshalle, surrounded by a tower-like building. The water is raised by pumping into a pipe, and is then discharged into a small stone basin, for the use of valetudinarians. A more concentrated brine is furnished by a neighbouring borehole. Trees and resting-places adorn the open spot in front of the well.

The saline '*Münster am Stein,*' wedged, as you see it, into the southern corner of the left Nahe shore, supplies also a drinking-well. The spring arises opposite the rocks of the Rheingrafenstein. The adjoining 'graduation-works' also afford a protected walk in unfavourable atmospheric conditions.

The Munster salt-works are the oldest in the neighbourhood. Their annals extend to the fifteenth century. Philip, Electoral Prince of the Palatinate, presented his two kitchen-masters, in the year 1490, with the salt and bathing well on the Nahe, between Ebernburg and Kreuznach, particularly a salt-well opposite Rheingrafenstein, on the condition of sending one 'Heller' (the sixth part of a farthing) to Alzey. For this impost they obtained leave to erect several bathing cabinets, and to hold their taverns there.

No mention is made of baths in subsequent records referring to the Rhine salt-works. Even in the eighteenth century, when the Karlshalle was erected, and ten years subsequently, the Theodorshalle, no other use was thought of but the preparation of salt. That in the commencement of the nineteenth century, no steps were taken to imitate other 'Salinen' in the erection of contrivances for bathing, is to be attributed to the peculiar political position of the works, which were allotted in the Parisian treaty to Hesse Darmstadt, while the ground is subject to Prussian dominion. It was not until 1820 that foreign visitors began to employ the baths. Three years subsequently, the first bathing cabinets were erected on the Karlshalle. The growing reputation of the baths caused the official residences of the Theodorshalle to be adapted for the reception of visitors. The subsequent discovery of the Elisenquelle formed a grand epoch for the rising Spa. New houses and hotels rose on all sides; old ones were rebuilt on a larger scale, or provided with additional stories, to meet the increasing demand. Between the Elisenquelle and the Carlshaller salt-work, you see the grand 'Felnersche Badehaus;' farther on, the capacious buildings of the Oranienhof. The same activity was observed in the erection and embellishment of buildings on the Theodorshalle. In the southern Münster, the inhabitants did not fail to contribute their share in furnishing convenient habitations and bathing arrangements.

The greatest praise, in causing Kreuznach to be so universally appreciated, is due to the personal and literary exertions of Kreisphysikus Geheimer and Sanitatsräth Dr. Prieger, who first attracted the attention of the medical profession by his pamphlet on the 'Iodine and Bromine Springs of Kreuznach,' in 1837. Baths of Kreuznach motherlye began to be tried in distant parts for scrofula and tetter with success, and many were induced to seek the Spa itself, which exhibited such efficacy by the concentrated contents of its water.

Not only was great benefit obtained from the exported Elisenbrunnen water, but its imitation in Struve's establishments afforded great utility, and swelled the lists of patients cured through the agency of Kreuznach. The fame of its powers spread wider and wider every year, attracting invalids from most distant localities. All the springs resemble each other in qualitative properties, although somewhat differing in temperature, according to the respective depths of the boreholes, and according to the greater or smaller exposure of the subterranean reservoirs to atmospheric influences.

The Elisabeth, or *Elisenquelle,* issues at a temperature of 10° R. (54½° F.) with a specific gravity of 1·004. The taste is saline, bitterish, rather nauseous; the appearance transparent, with a somewhat yellowish tint. Only very few bubbles of carbonic acid gas rise to the surface in the water drawn. Brownish flakes soon separate themselves, and fall to the bottom of the vessel. According to Professor Löwig, of Zurich, the water contains 94 gr. (90 according to Bauer) in sixteen ounces—viz.,

72·88	chloride of sodium.
13·38	„ calcium.
4·07	„ magnesium.
0·62	„ potassium.
0·61	„ lithium.
0·27	bromide of magnesium.
0·03	iodide of magnesium.
1·69	carbonate of lime.
0·01	„ baryta.
0·10	magnesia.
0·15	oxide of iron.
0.02	phosphate of alumina.
0·12	silica.
94·02	

The alumina, silica, and iron become soon deposited. Bauer has less chloride of magnesium, and no lime; in other respects, the analyses agree, with the difference that Bauer calculated the iodine and bromine in combination with sodium, which possesses a greater atomic proportion than magnesium; so that Bauer's 0·31 bromide of sodium, corresponds with Löwig's 0·27 bromide of magnesium. The temperature of the Karlshallerbrunnen is 12° R. (59 F.) at the issue, but higher in the borehole. The taste is less saline, owing to a smaller amount of solid ingredients. It contains seventy-five grains of solid constituents in sixteen ounces (59 chloride of sodium, 2½ chloride of calcium, 6·6 bromide of calcium, 1·36 bromide of carbonate and crenate of iron, and nearly 4 cubic inches of carbonic acid).

The chief well of the *Theodorshalle* has a temperature of 17° R. (70$\frac{1}{4}$° F.) Its constituents amount to 87·9 grains.

The chief well of Münster greatly resembles that of the Karlshaller, with a temperature, however, of 22° R. (81$\frac{1}{2}$ F.) The amount of solid ingredients varies from 64 to 76 grains. It is smallest in winter, when the spring is not in requisition. The green mud covering the bottom of the graduation works is composed of organic matter.

After the salt has been crystallized and removed from the boiling-pans, the remaining brownish-yellow glutinous liquid is called *mother-lye.* The smell bears some analogy to that of *fucus.* The taste is bitter, astringent, and caustic. Specific gravity varies from 1·307 to 1·314. It contains in sixteen ounces, 2575·72 grains, or about the third of its contents—viz.

1577·71	chloride of calcium.
338·72	bromide of calcium.
92·82	bromide of potassium.
154·10	bromide of sodium.
60·34	chloride of sodium.
38·44	chloride of magnesium.
17·30	chloride of potassium.
35·66	alumina and protoxide of iron.
216·13	crenic acid, two resinous substances, with traces of iodine.
44·50	water of crystallization and loss.

The origin of the salt-springs is generally due to strata of rocksalt, into which atmospheric water had previously penetrated; the adjoining layers of lime and gypsum cause the addition of salts of calcium or of sulphates.

The inconsiderable depth of their origin causes the temperature to be comparatively low, and the combination less intimate than in those of a more profound origin. The sources of Kreuznach being confined to the extension of the porphyry between the Elisenquelle and Rheingrafenstein, the comparatively small amount of chloride of sodium, the presence of certain substances not belonging to salt-rocks (as lithion, phosphate of alumina, and chloride of potassium, &c.), and the corresponding analysis of porphyry, led to the belief that this latter rock gives birth to the Kreuznach springs.

Professor Löwig obtained from the solution of porphyry an artificial water, containing all the chief ingredients of the sources. Some deposits of salt may, according to Sanitätsrath Dr. Engelmann, be interspersed amongst fissures of porphyry: the water must have penetrated into greater depths than the mountain heights would indicate, to dissolve the porphyry; for sweet water issues at the foot of the mountain near the salt-springs—the result of meteoric water merely penetrating a short distance through the superficial layers. The quantitative difference is accounted for by the varying relative contents of the rock itself at different parts. Greater warmth exists in the depth, and if the temperature lowers more in one spring than in another, this depends on a longer contact with superficial earthy layers before its emission. In the Karlshallerquelle, the brine formerly exhibited the temperature of 12° R. when the bore-hole was 150 feet deep. Boring only 200 feet more, produced brine of 16° R.; whilst the present depth of 600 feet furnishes water with a temperature of 19° R. (74¾° F.); the augmentation you will find in greater proportion than you might expect from such an inconsiderable depth.

The general rise is about 1° of Reaumur to 150 feet, so that it ought to be 4° of R. or 9° of F. less, if there were not some counteracting cause. This is sought in the circumstance, that porphyry may have retained its volcanic heat longer than the surrounding rocks of older volcanic origin, amongst which it had to force a passage. The water of the Elisenquelle had formerly the temperature of 8° R. Now, when the depth of the bore-hole has only been increased to 36 feet, the water drawn in the depth has a temperature of 11½° R., and at the issue 10° R.

The shorter or longer stay of the water in the basin likewise influences its heat. Thus, the temperature of the chief well in Münster only amounts to 21° R. (79¼° F.) in the shaft, if pumping has been discontinued for some weeks, whilst the heat rises to 23° R. (83¾° F.) during ordinary use. The different degree of cooling in the sides, and the admixture of more or less cooled brine in the side walls of the bore-holes, likewise exercise their influence in this respect. The carburetted hydrogen found in the new bore-hole of the Karlshalle, and in the chief shaft of the Münster spring, is ascribed to some layers of coal existing in the older coal-sandstone found near the porphyry in the neighbourhood of the Rothenfels.

If the taste of the water appears more saline one day than another, this is rather to be attributed to altered gustatory function than to any change in the relative contents of the water. Though nauseous and bitter, it is borne well by the digestive organs, if the doses are regulated according to the state of the bowels. Appetite improves under the use of the water, but alvine action is not promoted at first—only after gradual increase of the quantity does this result take place. Should the water be taken too quickly, or in too large quantities, the abdomen will be distended, and eructation, pain of the stomach, and diarrhœa will ensue, with a general feeling of chilliness. The same result may follow dietetic irregularities, the partaking of acidifying food, &c., as in Weilbach, where the bowels are more acted upon in unfavourable weather, from the impeded function of the skin. The baths are generally taken lukewarm, with additions of mother-lye in larger or smaller quantities, according to the state of the disease. The skin becomes somewhat irritated after a time, and bath-eruption is a frequent consequence. Patients with very tender skin will sometimes bear greater quantities of the mother-lye than comparatively inured and healthier persons. The brine is also employed as a clyster, in which form it displays its specific results, and is particularly effective as a solvent in cases of induration of the prostate gland. The exhalations of the graduation works are also used for medicinal purposes in similar instances as those of Kissingen.

The vapours evolved during the boiling of the brine are frequently found efficacious in chronic catarrhs of scrofulous subjects. They would of course injure in real plethora or tendency to congestion. After some weeks, a sudden sensation of languor occasionally appears, with headach, debility, disinclination to bathe, or to drink the water, feverish excitement, &c. These are signs of saturation, and require cessation of the course.

The chief efficacy of Kreuznach must be sought in the chloride of sodium and of calcium, and in the iodine and bromine contained in the springs. The Elisenbrunnen has the strongest effect; the Carlshaller spring acts less powerfully, from the minor quantity of ingredients. If a still weaker spring is required, the Münster well is recommended. In cold and damp weather, the warmer water of the latter agrees better with the digestive organs, as does that of the Theodorshalle, than the colder springs would; the reverse takes place in fine weather. A great advantage of Kreuznach over similar springs with a prominent amount of iodine and bromine, lies in the circumstance that we may employ Kreuznach both internally and externally in appropriate diseases, whilst in many powerful springs of the same class the physician is either restricted to internal administration (as Adelheidsquelle of Heilbrunn, through the scantiness of supply) or to external (as Oeynhausen, Ischl, &c). This double action becomes highly important.

The chief indication for Kreuznach is *scrofula*. If the lymphatic system be impeded in its function, nutrition of the body must suffer generally; hence the Protean complaints arising out of scrofulous dyscrasy. The secretions become vitiated from the abnormal state of the blood, reproduction is impaired, and the whole body must suffer in consequence. Dr. Engelman dissents from the assertion frequently made, that the bromine and iodine springs are more adapted to torpid forms of the disease, whilst to erethic scrofula those springs whose chief ingredient is carbonate of soda are more applicable. Dr. Vogler, of Ems, supports this objection, and limits the preference of Ems to mesenteric scrofula and tubercular diathesis.

In whatever form the disease may appear, whether the glands of the neck be swollen and indurated, or whether the eyes, ears, nose, mesenteric glands, or bones, become affected, Kreuznach will be found highly beneficial. The cases for which the present spa should be selected will therefore be easily distinguishable. You meet with patients, mostly in early age, still affected with marked scrofula, or with chronic diseases of the skin, weakness, lacrymation of sight, nervous tremulousness, or lassitude after inconsiderable exertions: their complexion is florid, their skin tender and very susceptible, their digestion irregular; appetite often excessive, with a deficient power of assimilation. Scars of former ulcers, or anamnesis, inform you that scrofulous acrimony still lurks in their blood. By recommending the careful use of Kreuznach you will afford such patients a great chance of a radical cure.

The spa is contraindicated in organic diseases of the heart or great vessels, in inflammation, fever, dropsy, and congestion to the brain or other vital organs. As regards the use of the water, or the quantity to be taken, this depends in a great measure on the nature of the disease and constitution. As a general rule, it is advisable to commence in small quantities, and not to drink the next glass before we feel that the last has been properly digested. As is the case in all remedial measures, especially against chronic diseases, a slow and gradual imbibition of the healing substances will produce a safer effect than overloading the stomach with quantities of the water poured down in rapid succession. By the latter practice, a violent action will be excited, the irritated intestines will discharge the distending mass as rapidly as possible, and the lymphatic system will lose the opportunity of gradually absorbing the required ingredients. From the prevalence of iodine and bromine at Kreuznach, we need not compare the indication with that of Homburg, Kissingen, or other saline springs. With the above precautions and exceptions, it will be sufficient to convince ourselves that scrofula forms the base of the disease, in order to advise unhesitatingly a visit to Kreuznach. In some instances the water agrees better if mixed with a little hot milk; or, in cases where an excessive stimulation is feared from the presence of iron, the water should be allowed to stand for some time, till its iron becomes deposited. The great assistance afforded by the baths, and the various quantities of mother-lye with which they are impregnated, are too apparent to need further allusion. A great advantage of Kreuznach consists, further, in the possibility of employing it at a distance; and I may bring a case to your notice of a clerk in a foreign counting-house in this city, who laboured for about three years with scrofulous struma. He applied to me for advice after two years of medical treatment. I prescribed the ordinary preparations of iodine and other anti-scrofulous agents for about nine months, with no better result than my predecessors. At last, I discontinued all other medicines, and recommended Kreuznach water, a wine-glassful only, three times a-day, mixed with some warm water. To my own surprise, the first trial proved most successful. One dozen bottles sufficed not only to produce a cure of his present ailment, but his general state of health became greatly improved. His pallid and puffy appearance gave way to a more healthy complexion. The inconvenience in breathing and speaking, so marked in this disease, entirely vanished; and it would now require very close inspection to perceive a slight remaining enlargement of the thyroid gland, which would not be noticed without the knowledge of his former disease. I must not omit, however, to mention one fact with reference to this case, which may detract considerably from its therapeutic value—viz., the patient in question was suddenly affected with acute inflammation of the thyroid gland, just after finishing a course of the water, with angina and febrile excitement, necessitating antiphlogistic treatment. After recovery from this attack, rapid absorption and diminution of the enlarged gland to its present almost normal state took place, so that this inflammatory process may have assisted the removal of the struma as powerfully as the mineral water.

Nevertheless, as the Kreuznach water may have increased the function of the gland, and disposed it to take the form of acute disease, probably induced by atmospheric causes, I feel justified in ascribing the cure in a great measure to the Kreuznach water. This happened about five years ago, and the patient's health has been perfectly good ever since, with the exception of an idiopathic bubo, from which he suffered last year. He was at that time residing at some distance from town, so that I had only an opportunity of seeing him once after he had been laid up for several weeks. I found no reason to recommend an alteration of the judicious treatment adopted by his medical adviser, consisting of tonic and solvent remedies. A short residence at the sea-side completed the cure, and restored his former health. This shows the scrofulous dyscrasy to be probably still lurking in him. A visit to Kreuznach, if ever any unfavourable symptom should reappear, would doubtless eradicate the prolific cause of disease.

As regards the physicians of Kreuznach, I have to mention, besides the two distinguished names of Geheimer Sanitätsrath Dr. Prieger, and Sanitätsrath Dr. Engelman, those of Drs. Hahn, Jung, Oscar Prieger, Wiesbaden, Schweich, Theveny, &c.

Now, Gentlemen, you must again allow me to take you to some distance for the purpose of comparison. Imagine yourselves at *Munich*, the capital of Bavaria, which we passed in our journey to Gastein, the Tyrol Spa.

Adelheidsquelle.—About eight German miles to the south of Munich, between the village of *Tölz* and the former convent of *Benedictbeuern*, you enter the small village of *Heilbrunn.* It is nearly two leagues distant from the former, and one and a quarter from the latter. The height of Heilbrunn is calculated at about 2400 feet above the level of the Mediterranean sea, Benedictbeuern being nearly 2000 feet high; you find it due west of Kreuth, not far from the left bank of the Isar, which descends from the Algauer Alps, and proceeds northward to intersect the artistic city of Munich, running for some time parallel with the Lech. After having been fed by the Ammer, on the left bank, it passes Landshut, and at last mingles its waters with those of the Danube, about midway between Regensburg and Passau. Its latitude is 48°, its longitude east 12°. It lies at the foot of an Alpine promontory, on an eminence affording very charming and distant prospects. In the north you perceive a beautiful valley, with gently-rising hills, covered with woods, extending to the Würm, or

Staremberger Lake, (through which the Würm filters its water previously to its junction with the Ammer.) North-east, on the right shore of the Isar, you perceive an immense plain, reaching as far as Munich. Towards the north-west, the towering Peissenberg arrests your eye (south of Weilheim). The southern Alpine promontories are easy of ascent, and repay a traveller for his trouble in climbing them, with extremely picturesque and romantic views. Behind these rises the Zwieselberg, and this height is again overtopped by the towering *Benedictenwand,* upwards of 6000 feet high. The Kochel Lake and Benedictbeuern lie somewhat lower to the south and west. The chief mountainous formation of the environs consists in marl-sandstone and peat-sandstone. In the torrents near Heilbrunn, several calcareous petrifactions are found, besides granite, glimmer, and slate of hornblende. The spring lies between two hills, the vicarage being on the smaller, and the church on the higher eminence. It is said to be the oldest of the Bavarian springs. In the year 955 it was destroyed by the Hungarians, together with the convent of Benedictbeuern. One hundred years afterwards, the monks caused the place where the well had stood to be dug again. The source was discovered at a depth of four fathoms, but flames arose, and it was thought that the spring originated by a miracle. It is related that in the year 1659, the Electoral princess Adelheid, wife of the Electoral prince Ferdinand, was advised to use the spring, after having been married eight years, without the hoped-for issue. A handsome bath-house was built for her accommodation, and the mineral water had a happy result. In a year afterwards the princess was delivered of a daughter, and had several other children subsequently. The well gradually fell into decay again, as it is supposed through the disinclination of the governing body to encourage visitors, from a fear of their becoming too frequent or too numerous.

After the extinction of the convent, Geheimerath *von Utzschneider* became proprictor of the cloister buildings and adjacent domain. He founded a glass manufactory here, where, among others, the glass of the celebrated *Frauenho-*

ferschen astronomical instruments is prepared. The spring was only employed by the surrounding peasants as a domestic remedy in scrofula, goître, and other glandular diseases, in dyspepsia, lithiasis, &c. The inhabitants also used it for making bread, as they then required less salt. But nobody cared for the preservation of the well, so that its decay progressed rapidly. The late Dr. Graf described the effect of the water in 1805, and framed rules for drinking and bathing; but they could not be carried out from the want of proper accommodation.

Utzschneider's property was at length sold to the State, and Professor Vogel, of the university of Munich, was commissioned to analyze the Bavarian mineral waters. When he came to Heilbrunn in 1825, and heard of the use which the neighbouring country people made of the well, he directly suspected the presence of a large amount of iodine, bromine not having been detected yet. Analysis confirmed this supposition. Having reported this discovery to the Royal Academy of Sciences of Munich, several distinguished physicians availed themselves of the spring in the following year, 1826. Medicinalrath Dr. Wetzler, visiting it from Augsburg, found it contaminated by mud and putrid wood. Large gas bubbles rose at three places, but did not redden litmus paper: thus the gas could not consist of carbonic acid. He took several bottles away with him, and found a successful result from its first trial, in a case of very painful vesical hæmorrhoids of eleven years' duration.

At his recommendation, Mr. Moritz Debler, a Munich merchant (native of Augsburg), purchased the spring from the State. The new proprietor then caused the well to be cleaned to the bottom (forty-six feet deep), and had a protecting enclosure constructed. Whilst the well was being cleaned, and when nearly exhausted of its contents, a gentleman descended with a lighted candle to inspect the source. Suddenly a great part of the surface of the water ignited, and was with difficulty extinguished.

A considerable layer of gas constantly hovers over the water. Dr. Wetzler attempted in 1837 to light it. The water having sunk five feet—through a considerable supply

—this process was thought difficult of accomplishment. A few boards were removed, and a girl present laid herself transversely on a beam to look down into the well. The vicar, who was also present, approached with a light to see how low the surface of the water had sunk. A sudden crash ensued, and a flame rose to the height of several feet. All were more or less injured by the explosion. The face and arms of the girl were blistered, and the eyelashes of the Brunnenmeister and the reverend gentleman were singed. Upon Mr. Debler requesting the king of Bavaria to give the spring a name from a member of the royal family, his majesty justly selected the name of *Adelheidsquelle*, in memory of the above-mentioned princess, who first contributed towards its reputation by the remarkable cure she there experienced.

Mr. Debler could not construct a bathing establishment, for he only owned twenty-eight square feet of ground with the spring. The wealthy peasants of the neighbourhood would not sell any space for building. He was therefore compelled to restrict his operations to the filling of bottles, and exportation of the water. The scantiness of supply was another inconvenience. The flow of water only amounted to six pints a minute: nevertheless, several persons resorted there, seeking accommodation in the village inn, or at some of the private cottages; whilst more opulent visitors took up their residence in the convenient Hotel of *Bichel*, which lies at the distance of one league from Heilbrunn, and a quarter of a league from Benedictbeuern, and enjoys the advantage of being crossed by the high road from Munich, Tölz, Tyrol, Weilheim, and Murnau. The water was sent to them in tubs for bathing. At present the accommodation is somewhat increased; and several valetudinarians seek the place annually, though its chief employment still takes place at a distance. An able physician is also now residing in the immediate neighbourhood (Dr. Schweiger, at Benedictbeurn). From the hotel of this place, a charming view is obtained of the southern Kochellake, of the former convent of Schlehdorf, and of the semicircular mountain boundary which rises most romantically from the lake-shore.

The more distant Tölz, on the Isar, enjoys a charming situation. A large garden adjoins the elegant hotel, and affords a beautiful view of the Iser valley. On the right bank of the Isar, the village of Langgries extends for nearly a league along the valley, and above it the superb Castle of Hohenburg looks down from the mountain height.

Tölz is celebrated for its beer: the rock-vaults there chiefly contribute to its long-preservation.

For further excursions, Tegern-lake and Bath *Kreuth* would be inviting, the Walchen-lake, the Starmberger-lake, &c. Tegern-lake is four leagues distant, and Kreuth seven.

The Heilbrunn-well has a diameter of eight feet above, and a smaller one at the bottom. The water issues out of three veins of sandstone. The ascending gas-bubbles may be ignited, and burn with a clear flame. The water is clear, colourless, and only sparkling when the well is strongly agitated. The odour is somewhat nauseous (bearing analogy to bromine, carburetted hydrogen, and sometimes to sulphuretted hydrogen); its flavour is similar to that of weak broth, and it leaves a mawkish taste in the mouth. The temperature is about 8° R. = 50° F. It contains 47 grains of solid ingredients in 16 ounces—viz.

	Kreuznach.	Hall (Austr.)
38·15 chlor. sod.	72·92	100·72
	(13·27 chlor. calc.)	2·99
0·20 iod. of sod.	0·003	5·53
(0·91 according to Fuchs)		
0·40 brom. of sod.	0·30	
(0·30 according to Fuchs)		(0·49 brom. magn.)
6·81 carbon. of soda.		
	(0·79 chlor. pot.)	(0·35 sulph. sod.)
0·23 carb. of potash.		
	(0·25 chlor. magn.)	0·05
0·12 carb. of ammon.		
	(0·29 carb. baryt.)	
0·62 carb. of lime		0·31
0·39 carb. of magnesia	1·35	0·17
0·05 carb. of strontia	0·68	
0·02 carb. of alumina		
0·01 carb. of iron	0·19	0·06
0·25 silica	0·31	0·16
47·31	90·68	114 grs.

and 4 cubic inches of carburetted hydrogen in 100 cubic inches.

The proportions of the constituents (with the exception of the iodine and bromine) bear some analogy to *Selters* water, which possesses likewise chloride of sodium as its chief ingredient (16¼ grains, and carbonate of soda, as the next in importance, 5¾ grains.) The Adelheidsquelle promotes, with reference to its muriatico-alkaline character, the functions of the mucous membranes of the lymphatic, glandular, uropoietic and uterine systems. The carburetted hydrogen is supposed to diminish the morbidly-increased sensibility of these organs, and to operate as an antispasmodic and anodyne agent. Add to this the very large amount of iodine and bromine (conjointly more than a grain in sixteen ounces) only exceeded in this respect by the Haller Kropfwasser (goître-water), and you will be prepared to hear of its powerful effect on scrofulous diseases and complications. You may judge, from the difference of constituents in the three iodine spas, the respective selections which you will have to make.

When, besides the highly solvent, antiplastic, and alterative power of the iodine and bromine, you find an indication for a prominent employment of chlorides, especially of sodium and calcium, your patient will have to resort to Kreuznach. You may thence expect a thoroughly penetrating influence on the whole reproductive system, the removal of the minutest traces of abnormal nutrition, and the counteraction of lymphatic torpor or glandular obstructions.

The quantity of chlorine entering the absorbent vessels, in conjunction with the sodium and calcium, must neutralize a great amount of that acrimonious dyscrasy characterizing the circulating fluids of scrofulous individuals. In short, we must consider that Kreuznach acts most energetically, and penetrates most deeply into the whole metamorphic function going forward in the glandular and lymphatic system. Hall of Austria (near Steyer), which excels the others by its larger amount of iodine (5 grains of iodide of sodium, according to Von Holger), contains also a considerably greater quantity of chloride of sodium (106 grains), and very little chloride of calcium (about 3 grains). Its name of Kropfwasser indicates its great reputation in scrofulous struma.

When we desire a simple employment of the two last mentioned remedies, and have no reason to fear a rebellious reception, by weakened or irritated digestive organs, or on account of general irritability or weakness, we cannot employ a better remedial means than the mineral water of Hall, which unfortunately cannot yet be obtained in this country. I hope, however, that on greater attention being directed to these highly important natural remedies, importers may find it lucrative to give the English public the choice of all those waters which do not lose their medicinal power by distant carriage.

The Adelheidsquelle contains the smallest amount of chloride of sodium (only thirty-eight grains, that is, about half of Kreuznach and a third of Hall), no chloride of calcicum and magnesium; less iron than Kreuznach ($\frac{1}{100}$ to $\frac{19}{100}$); but, instead, it possesses a prominent amount of carbonates (nearly seven grains of carbonate of soda, more than half a grain of lime, more than one-third of magnesia, and about one quarter of potash). Its iodine and bromine being not only more abundant than in Kreuznach, but also more prominent, by reason of the proportionally smaller quantity of other active ingredients, you may expect a series of special phenomena to result from the use of the Adelheidsquelle.

Whenever you consider iodine particularly indicated in formed and developed scrofulous swellings, without great general torpor of the vascular system, you will employ the Adelheidsquelle, especially if a cure may be reasonably expected by the mere internal use of an iodated water. A few cases, enumerated by Dr. Wetzler, will best illustrate the manifold uses to be made of the water:—

Dr. Von Breslau, of Munich, was summoned to consultation on the case of a lady who laboured under such considerable obesity that she could scarcely walk a few steps in the room without dyspnœa. He advised Adelheidsquelle for internal and external use, and it completely cured her. A girl of thirteen years of age had her abdomen so distended and hardened, from affection of the mesenteric glands, that she might have been supposed to be pregnant if her age had permitted such a supposition. At the same time, she vomited frequently after taking food, so that Dr. Von Walther considered the pylorus to be hardened and narrowed. Adelheidsquelle being recommended, she went to Heilbrunn, and returned cured after six weeks. Dr. Fuchs found highly satisfactory results from the water in gravel and lithiasis, and placed it, in this respect, on an equality with Carlsbad. He recommended the spa to a patient of sixty years of age, who had suffered from a renal calculus for about a year, and daily lost upwards of an ounce of blood from the bladder, which greatly reduced and weakened him. Six weeks' bathing and drinking at Heilbrunn restored his health.

Dr. Dietrich says he knows no mineral water which penetrates so deeply into organic plasticity, and which so powerfully agitates the vegetative sphere, by slowly operating on and altering its constituent elements. He cured with it obstinate chlorosis in scrofulous girls; testicular indurations, strictures of the urethra, &c. Dr. Xavier Martin found the Adelheidsquelle extremely curative in mesenteric atrophy of little children. Their emaciated appearance, pale complexion, hollow eyes, pointed noses, their voraciousness and clay-coloured excretions, their enlarged mesenteric glands, betrayed the evil, and induced the doctor to employ the water in small quantities, with or without warm milk. Success very frequently resulted. In scrofulous ophthalmia he found cold external applications of the Adelheidsquelle highly useful: in amenorrhœa and chronic ovaritis he witnessed decided cures from the spa.

M. Fellerer, from the Hospital of Incurables, states that J. M., thirty-eight years of age, had been affected from his childhood with various glandular swellings. Subsequently, scrofulous ulcers appeared on the right foot, and were complicated with caries; his illness was aggravated by an increasing enlargement of the thyroid gland, so that at his reception his struma was enormous, weighing about four pounds, and impeding respiration and speech more and more. After an ineffectual treatment by pharmaceutic remedies, Adelheidsquelle was ordered (which is furnished gratuitously to the hospital by Mr. Debler). Persevering employment of this remedy for six months effected a complete cure of the goître, and the patient would have been discharged but for the presence of the carious ulcers.

Dr. Horger relates an instance of incontinence of urine in a patient of eighty years of age, which was cured by the spa. Dr. Caron du Val cured with the same water several cases of chronic vesical catarrh, accompanied by spasms and pain of the bladder; also hepatic hypertrophy, induration of the neck of the womb, and of the mammary glands. Dr. Heigl, of Ratisbon, employed the water with almost specific efficacy in urinary disorders, especially in gravel, dysuria, eneursis, enlargement of the prostate gland, &c.

Dr. Wetzler records an instance of a gentleman who had suffered for eleven years from the most painful dysuria and urethral blennorrhage, resembling gonorrhœa, for which it was ineffectually treated. The patient had to get up several times at night, and walk about for hours in the room, to obtain relief from the violent vesical and urethral pains; and frequent involuntary emissions added to his distress. He was completely cured by Adelheidsquelle, and occasional doses of Pullna whenever his bowels acted too sluggishly. A child of ten weeks, emaciated and wrinkled in appearance, vomited after it had been fed, and had besides twenty to thirty alvine evacuations daily; the tongue was covered with mucus and small ulcers; the pulse almost imperceptible, and extremely frequent; the temperature of the abdomen and forehead heightened; and the extremities cold. The first child had died at the age of twelve weeks from consumption, and the mother was desolate at the probable loss of this her second child. Dr. Wetzler recommended her to give it some broth five or six times a day, and almond-milk to drink, and he sent her a bottle of Adelheidsquelle, with the direction to give the child two teaspoonfuls three times a day. After a fortnight, half the bottle was used, and the recovery so advanced that further medical treatment was dispensed with.

Increase of urinary secretion and improvement of appetite are considered as the invariable and immediate results of the water. Dr. Schweiger, of Benedictbeuern, communicates a case of scrofulous tuberculosis, with remittent fever, that had been cured at Heilbrunn, besides several scrofulous complaints. The Adelheidsquelle may then be employed with great confidence in scrofula, and in lymphatic struma. Acidity and inveterate mucosity generally prevailing in this habit, the utility of the carbonate and muriate of soda is apparent. As regards urinary complaints, the distressing strangury often occurring with a mucous urethral discharge (though no cause for gonorrhœa has existed) is invariably relieved by the Adelheidsquelle, the vesical piles deteriorating from the employment of the ordinary antigonorrhœal remedies.

The swelling of hæmorrhoidal vessels round the neck of the bladder, and the mucus formed in consequence, cause the bladder to become more susceptible. Hence, as soon as the irritating liquid arrives from the kidneys, pain is experienced, and contraction of the bladder ensues. But in proportion as this irritation increases, the vesical nerves become more susceptible, and thus they re-act against the irritating particles by spasms of the sphincter of the bladder, and of the contractile cellular tissue of the urethra. Thus, as soon as the urine collects at night, the patient is awakened by a painful desire of micturition, which, on trial, he cannot satisfy, in consequence of the spasmodic contraction mentioned. Such cases are extremely distressing, and become more intractable and complicated if treated with cubebs, copaiva, or astringent injections.

The utility of the spa in gravel and lithiasis is due to its carbonate and muriate of soda. For as most calculous diseases proceed from excess of uric acid or urate of ammonia in the blood, carbonate of soda, which neutralizes this acidity, is highly useful, urate of soda being formed and removed out of the circulating mass. The smaller number of calculi formed from oxalate of lime or phosphates are supposed to be favourably influenced by culinary salt, with anodyne and antispasmodic remedies, because, through a chemico-vital process, the oxalic acid may absorb another atom of oxygen, and become transformed into carbonic acid. This acid may yield its place to the chlorine, which forms a soluble chloride of calcium, whilst carbonic acid becomes attracted by soda. In those calculi formed from insoluble phosphates, the culinary salt is thought to act beneficially by attracting the phosphoric acid, which combines with soda into soluble phosphate of soda, whilst the chlorine may enter into combination with ammonia, and thus break up the hitherto compact insoluble mass. The Adelheidsquelle, containing both these curative salts, is naturally very efficacious in various forms of lithiasis and gravel.

As the blood is thought to owe its stimulating property to the muriate and carbonate of soda, a diminished proportion of these salts, with an abnormal preponderance of phosphates and urates, must engender acrimony, dyscrasy, and deviation from health. Hence the utility of introducing these salts into the blood is justly insisted upon. The wasting of the mammary gland occasionally observed under the pharmaceutic use of iodine never occurs through the employment of Adelheidsquelle. It may be asked, if this spring is so eminently efficacious, how could its reputation have been dormant for such a length of time? To this I may answer, that the rapid progress of mineral waters in public and medical estimation now a days, is due to the increasing determination of the profession to seek out, with unceasing efforts, the causes of the morbid changes, and to combat them rather than to palliate ailings by momentary soothing remedies, which leave the remote source of the evil untouched. In fact, the advancement of civilization and enlightenment has wrought a complete change in our science. Whilst, in former times, the followers of Hippocrates were divided into sections and parties, the one deriving all ailments from a surplus, the other from a deficiency of blood, the third from a depraved composition, the fourth from moral causes, the treatment was more in accordance with the established maxim of each sect than with the nature of the disease. The one treated all diseases by detractions, regardless of the healthy blood that left the body with the unhealthy; the other endeavoured to root out every disease by incessant purging; the third employed arcana, and enlisted adherents by reports of real or pretended cures, &c. Now, however, our profession knows of but one system, which is to search out, in each instance, the cause of the derangement, and to combat this in the most rational manner. Hence more attention is paid to the chemical action of remedies, and unwillingness exists to employ a remedial agent if we cannot give to ourselves a satisfactory explanation of its action. The maxim of 'removeas causam, removetur effectus,' is too sound and too much based on reason to be ever shaken or supplanted by another.

LECTURE XV.

NENNDORF. — EILSEN. — MEINBERG. AIX-LA-CHAPELLE.

GENTLEMEN,—Let us now pursue our journey. We return to Bingen and embark in a Rhine steam-vessel, to remain in it till we reach Cologne. Hence we cross the bridge and travel by the Northern railroad from Deutz, through Hamm, Minden, &c., to Bückeburg; the distance is performed in about ten hours. From this place we have only to avail ourselves of one of the usual conveyances to reach *Nenndorf*, which lies at five leagues distance, in the principality of Lippe Schaumburg, and the same distance from the more northern capital of Hanover. It belongs to Electoral Hesse. Its latitude is 52°, east. long. 9°.

About 300 years ago, a contemporary of Luther, the naturalist, George Agricola, mentions a source which, according to his description, appears to refer to Nenndorf. On account of the disagreeable odour proceeding from the well, the inhabitants used to call the locality—'auf dem Teufelsdreck.' But no particular notice was taken of the circumstance, and even as late as 1784, the learned Erhart complains of the non-appreciation of such a powerful sulphurous water, though some steps had already been taken a few years previously to clean and enclose the well.

The Electoral Prince William I. is considered as the founder of the Spa. About sixty years ago, he had the buildings constructed, which were improved by his successor, William II.

The season lasts from the 1st of June to the 1st of September—only three months. Here, again, provisions are made for supplying the necessary accommodation gratuitously to indigent invalids. The arrangements of the baths are excellent in every respect. The so-called *Esplanade* serves as a rendezvous for the valetudinarians, who collect in the morning to drink their prescribed draughts, while entertained with music. A pleasant park affords numerous walks for exercise.

In the heat of summer, a covered and shady walk leads to a gentle eminence, from which numerous localities in the charming environs may be discerned. Temple-like enclosures and benches for resting are interspersed about the different walks, and give the fatigued pedestrian an opportunity of viewing the scene from a contemplative and quiet resting-place.

You will not find such luxury and pleasure-seeking here as in the Nassau and other Spas, the manner of living being conducted on a more moderate scale. Nenndorf possesses four principal springs: three of these arise at the Esplanade, near each other. The seasons exercise a very slight influence on the quantity of the water, which is considered as a proof of its having avoided contact with atmospheric water in its subterranean course.

The *obere Brunnen* or *grosse Badequelle,* about 200 feet from the 'Trinkquelle,' supplies 2500 cubic feet of water in the twenty-four hours, which is chiefly used for the preparation of baths. An extensive reservoir is constructed near the source.

The second spring, the *Quelle unter dem Gewölbe,* (source under the vault,) lies nearer the drinking spring, in the neighbourhood of the Arcade and bathing-house. About 2000 cubic feet of water are supplied in twenty-four hours.

The '*Trinkquelle*' (drinking-spring) has a basin of four feet in depth, and supplies about 3300 cubic feet of water per day.

The fourth spring lies about half a league farther, 'auf dem breiten Felde,' (on the broad field): rarely used for baths; its supply is 2400 cubic feet per day.

The rocks are chiefly composed of lias formation, distinguished as it is by petrified remains of antediluvian vegetables and animals, and consisting of alternate layers of sandstone, marl, marl-slate, and limestone, which respectively compose the neighbouring mountains.

The temperature of the three first sources is 9° Reaumur = $52\frac{1}{4}$° Fahrenheit, summer and winter. The water is perfectly clear and colourless, and no rising of air-bubbles or sparkling can be observed. The smell of sulphuretted hydrogen is very marked in all: the taste bitterish. The water is freely drunk by the inhabitants, even in a heated state of the body, with impunity. If the sulphur water be left exposed for some time in an open vessel, small air-bubbles arise, composed of sulphuretted hydrogen and carbonic acid. After some time, the water becomes turbid, till a deposit of sulphur and carbonate of lime restores the former clearness. To cause as little loss of the efficient gas as possible, the baths are heated with vapour generated by the sulphur-water. As regards the composition of the springs, they vary more in quantitative proportions than in quality. The Gewölbequelle is the most abundant; the Trinkquelle less, and the Badequelle least. For the baths these three are conjointly used.

Sulphate of lime or gypsum is the principal ingredient ($6\frac{3}{4}$ gr.), the next is sulphate of soda (nearly 5 gr.), then carbonate of lime ($4\frac{1}{2}$ gr.) and sulphate of magnesia ($2\frac{1}{2}$ gr.), chloride of magnesium ($1\frac{1}{2}$ gr.), sulphate of potash ($\frac{1}{4}$ gr.). Besides some alumina and bituminous substance, a combination of hydrosulphuric acid with sulphuret of calcium exists in the water, so that when the free sulphuretted hydrogen has been all evolved by boiling, and paper prepared by moistening with a solution of acetate of lead ceases to be darkened by it, you have merely to add a few drops of sulphuric acid, when the separation of formerly combined sulphuretted hydrogen will become immediately manifest by a brown or black colouration of paper prepared as before. About $4\frac{1}{2}$ cubic inches of free carbonic acid and $1\frac{1}{5}$ cubic inches of sulphuretted hydrogen gas, with traces of nitrogen, are contained in sixteen ounces—altogether, in the drinking spring, $20\frac{3}{4}$ gr. of solid and $5\frac{1}{2}$ gr. of volatile ingredients. The formation of the peculiarly composed sulphurous water is explained in the following manner. The mountains possessing a great quantity of gypsum, it may be supposed that a part of the sulphate of lime dissolved in the subterranean water has been gradually reduced by the contact with organic or bituminous substances to sulphuret of calcium. Free carbonic acid, formed in the interior of earth permeating the water, causes a portion of the sulphuret of calcium to be decomposed, so that carbonate of lime is formed on the one hand, and kept in solution by the excess of carbonic acid, whilst free sulphuretted hydrogen exists on the other, through the displacing power exercised by carbonic acid.

Dr. Wöhler illustrated this view by saturating a bottle of common well-water with gypsum, and then impregnating the solution with carbonic acid gas. After a few slips of wood had been introduced as the deoxidizing organic substance, the bottle was closed and made air-tight. After less than three months the water exhibited all the properties of a sulphurous water both as regards smell and taste, and in reference to the precipitation of metallic solutions; when boiled it became turbid, and deposited carbonate of lime.

The Quelle unter dem Gewölbe contains $21\frac{1}{2}$ grains of solid, and $6\frac{1}{2}$ cubic inches of volatile ingredients; the Badequelle 12 1-5th of the former, and 3 2-5ths of the latter. A small quantity of ammonia has also been found in the springs; also some silica; no carbonate of soda, no chloride of sodium, as in Weilbach. The sulphur water acts as a heating, stimulating, solvent, and alterative agent, gently promoting the functions of the secreting organs, whilst the pure sulphur does not display its effects on the intestinal mucous membrane, and merely acts healingly after absorption into the circulating liquids, the sulphurous water increases, by its saline admixtures, the secretion of the mucous membrane into which it is imbibed. The capillary vessels and their nervous ramifications are particularly exposed to this action. The circulation of the portal system is greatly promoted, and thus abnormal action of pelvic organs becomes regulated. The observed decrease of pulse so frequently noticed in the baths must be ascribed to the more equable general circulation resulting from the freer movements of the portal system. Nevertheless, they act more favourably in phlegmatic individuals not inclined to congestion, with a more atonic vascularity, and with a preponderance of the lymphatic and venous system over the arterial. Wherever inflammation exists, or fever, or tendency to cerebral congestion, to active hæmorrhage, to abortion, or to scorbutic dyscrasy, the water is contra-indicated.

The utility of the Spa in chronic rheumatism is ascribed to the improvement in the peripheric system, which thus counteracts the remote cause of the disease. In chronic exanthemata, Nenndorf frequently acts as a curative means, especially in those arising from repressed or neglected itch and other eruptions.

The specific influence of sulphur in the improvement of the cutaneous functions, with its general anti-dyscrasic power and beneficial action on abdominal reproduction, is here called into requisition. In asthma psoricum it is particularly extolled. Pulmonary catarrh appearing during cessation of catamenia is considered as an indication for Nenndorf, particularly if any hæmorrhoidal tendency exists. In varicose ulcers, mud-baths have shown themselves highly useful, also in non-febrile hydropic affections, particularly of persons of the lower class, who had been addicted to ardent beverages. Dr. D'Oleire found his Spa very useful also in metallic poisoning by lead or mercury; in scrofulous dyscrasy of a torpid character, in tumor albus genu, particularly when the pain is more fixed and the swelling hardened, so that a scrofulous base is to be suspected, local mud-baths and douche of sulphuretted hydrogen have been found useful. Adulteration of wine with preparations of lead is detected by the Nenndorf water assuming a brownish black colour if three parts of it are mixed with one part of the wine. In atonic, anomalous gout with deposits in the joints, contractions, &c., the external use of Nenndorf is highly efficacious; also in arthritic diathesis.

Catamenial derangements based on disturbed cutaneous function, particularly where the lymphatic and venous systems predominate, are relieved here.

The mud-baths form a highly important remedial means. The peat soil is obtained from the neighbouring village of *Algesdorf*, where also several sulphur-springs exist, impregnating the marshy soil. They are prepared in a peculiar building with an adjoining reservoir and mud-mill. In the autumn, the former is filled with the peat-soil, and then purified by the mill. Sulphur-water is conducted into this reservoir to wet the mud and prepare it for use. It is stirred and worked from time to time, and used in baignoires during the season. It is warmed by heated sulphurous vapours. The mud is blackish grey, and has the consistence of a thick pap with a strong smell of sulphuretted hydrogen. If boiled, the evolution of sulphuretted hydrogen lasts longer than if the sulphur-water be used, and if this separation ceases, it will recommence by adding an acid. Milk of sulphur is likewise contained in the mud. If it be dried and carefully heated, sublimed melted sulphur is observed at the bottom. If you boil the dried mud with alcohol you obtain a pale yellowish solution, which becomes turbid at cooling, and leaves a brownish glutinous mass, burning, after evaporation, with a vivid flame and distinct smell of sulphurous acid; humus and crenic acid are likewise present. In destructive distillation, the dried mud shows the characteristics of a nitrogenous organic substance. The liquid products are alkaline, and contain a considerable amount of carbonate of ammonia and sulphuret of ammonium. The salts of ammonia immediately show themselves by wetting with caustic potash; they are supposed to result from the decomposition of the vegetable albuminous substances which chiefly constitute the mud. The mud-baths highly stimulate the function of the skin, and generally increase the frequency of pulse. They are said to act as derivatives from the pulmonary and intestinal mucous membranes, and are indicated in chronic rheumatism and gout, in deficient action of the peripheric system, in contractions, exanthemata of a torpid character, as dry tetter, induration of the cellular tissue, varicose ulcers, with hardish livid borders, &c. In obstinate syphilis, cure was several times effected by sulphur-baths alternating with mercurial unction.

A young man, of about thirty years of age, with a light florid complexion, and exhibiting traces of former scrofula, visited Nenndorf, and placed himself under the care of the late Dr. D'Oleire. He had been infected several times, and subjected to various appropriate methods of treatment, with and without mercury, to no purpose. He had ozæna and ulcers of the uvula and fauces, with nightly pains in the bones of the skull, and characteristic humid ulcers on the forehead, arms, and thighs. The internal and external use of the Spa made all syphilitic symptoms more prominent still. The baths alone were therefore continued, and at the same time grey mercurial ointment rubbed in twelve times daily, according to Rust's method, whilst internally a strong decoction of sarsaparilla was taken. Complete cure ensued. Other cases are recorded where the sulphur baths were used first, and then inunction for sixteen days, followed by drinking and bathing. The successful simultaneous employment of these two apparently opposite remedies may be explained by the increased power of reaction produced by the baths, preventing too great atony of the lymphatic system, which might easily follow an energetic course of mercury. Besides, salivation is avoided, and thus a greater amount of mercury may be given with less injury to the system. However specifically mercury may act in syphilis, we occasionally find inveterate cases obstinately resisting the influence of this remedy. It is rational to imagine that the lymphatic system may occasionally become too much weakened to elaborate the metal so as to neutralize the venereal poison in the minute capillary ramifications. In such instances, we penetrate the lymphatic system with the stimulating sulphuretted hydrogen, we restore in some measure the natural systemic reacting power, and cure ensues by a subsequent proper reception of the remedy. *Gas-baths* play a very prominent part in Nenndorf. The sulphur water is made to stream fountainwise out of a basin in a large saloon, splashing from the height on a copper projection, from which the sulphuretted hydrogen gas spreads abroad. Scarcely a trace of the gas is found in the water which afterwards collects in the basin, a proof of its efficient separation by the violent contact with the copper. Sofas, tables, and benches are provided for a shorter or longer sojourn of the patient, besides some smaller gas-chambers for separate use. The pulse becomes diminished under the use of this, and the irritability of the respiratory organs allayed, whilst the secretion of the pulmonary mucous membrane becomes improved. Sometimes giddiness, oppression, headache, trembling, &c., are experienced at first by very sensitive persons, but these symptoms soon subside. Cases of phthisis pituitosa are mentioned where these gas-baths have been useful conjointly with a careful internal employment of the water. Local gas-baths are more especially recommended in deafness and blenorrhage of the meatus auditorius. The gas is here slightly warmed, and applied by means of an elastic tube. These local baths have proved particularly useful when rheumatism or gout has formed the remote cause of the evil. Douche of sulphur water behind the ear is sometimes added. The gas probably acts as a revulsive from internal organs by promoting the function of the skin. On the other hand, the admixture of a small quantity of sulphuretted hydrogen with the air may have a certain emollient influence necessitating a diminished dilatation of the pulmonary cells; hence its beneficial influence may be explained. But the remedial means do not end here. *Brine-baths* are administered; the Soole is led into Nenndorf by subterranean pipes from Rodenberg (half a league to the south), connected with Nenndorf by a beautiful walk. The specific gravity of the Soole is 1·013. It contains ninety grains of solid ingredients in sixteen ounces.

Springs of Nenndorf (cold).

	Quelle unter dem Gewölbe.	Trink-brunnen.	Badequelle.	Soole of Rodenberg.
Carbonic acid	5·2 cub. in.	4·32	2·75	0·14
Sulphuretted hydrogen	1·21	1·20	0·61	
Sum total of ingredients	21·4 gr.	20·7	12·19	90·
Sulphate of soda	5·22	4·91	1·11	10·81
„ magnesia	2·83	2 54	1·89	10·01
„ lime	7·15	6·81	5·56	14·82
„ potash	—	—	—	0·10
Chloride of sodium	—	—	—	49·84
„ magnesium	1·63	1·62	0 42	10·01
„ lime	4·30	4·51	3·18	4·61
Silica	0·05	0·06	—	0·20

The brine-baths are sometimes used conjointly with sulphur-baths, sometimes alone, whilst the sulphur water is taken internally. They especially increase the action of the glandular and lymphatic systems. They must not be employed in congestion of the external skin, great general debility, anæmia, syphilis, painful eruptions, tendency to scurvy, &c. In dry chronic tetter with great sensibility of the skin, they are mixed with sulphur water and greatly recommended, also in rheumatism and exanthematic metastasis. Some bromine and iodine are contained in the motherlye, which is therefore often added to the baths. Sometimes the saline baths are used as an after cure to increase the tone of the skin and diminish its susceptibility to atmospheric changes, or its tendency to profuse perspiration. Whilst the sulphurous water acts as an emollient, the saline liquid engenders reaction, and restores the tone of the skin. In different forms of herpes, catamenial anomalies, &c., a mixture of the two waters proved very useful.

Dr. Grandidier reports several cases of gout, arthritic paralysis, &c., which were cured by mud-baths, vapour-douches, and sulphur-baths, also a case of aphony with ulcers in the larynx, occurring in a young person of nineteen years of age, who had not yet menstruated. Gargles of the sulphur water were used, gas-baths from two to four hours daily, and cure followed.

A great advantage of Nenndorf lies in the circumstance that the baths are situated below the springs, so that the water runs in freely and need not be pumped in, whereby loss of sulphuretted hydrogen might take place. Physicians, besides Dr. Grandidier, Drs. Cordemann and Heimreth.

If we compare Nenndorf with Weilbach, a circumstance strikes us very much—viz., in the former the variations of external applications are extremely numerous and complete, and very frequently employed; whilst in Weilbach the chief mode of employment is internal.

What is the reason? You have merely to look at the difference of composition to obtain a solution of this problem. The chief constituents of Weilbach are carbonate of soda, of magnesia, and of lime, with chloride of sodium, a combination which must be well tolerated by the digestive organs, and which, with the abundance of sulphuretted hydrogen absorbed in the intestinal canal, promises the good results which are actually obtained from its use. In the manifold external applications of the Nenndorf water, I see an attempt at impregnating the organism with the healing sulphuretted hydrogen gas without the concomitant ingredients. For whilst carbonates preponderate in Weilbach, we find sulphates prevail here, and among these nearly a third of the whole is furnished by sulphate of lime, which may be expected to neutralize partially the increased peristaltic motion that might otherwise be induced by the sulphate of soda and magnesia present, so that the carbonate of lime, instead of assisting the antacid and sedative influence of the soda and magnesia, as in Weilbach, may remain unchecked to a certain extent, and require the digestive organs to be more integrant in order to its being well tolerated. A different class of diseases therefore naturally claims relief at Nenndorf to those at Weilbach. Chemico-vital action is relied upon in the latter for the chief curative result in hæmorrhoids, and diseases based on hæmorrhoidal tendency or obstruction of the portal vein; whilst at Nenndorf the dynamical and physical powers of the sulphur water, gas, douche, and mud-baths are called into requisition. Hence gout, rheumatism, articular swellings, and contractions are the most numerous class of complaints here. The increased frequency of pulse observed from the use of the mud-baths, and frequently expatiated upon as a peculiarity of Nenndorf, in contradistinction to other sulphur mud-baths, as Eilsen, for instance, is probably due to the high temperature at which they are used; for whilst the water-baths are taken at a temperature of 26° to 28° R. (90½° to 95° F.), that of the mud-baths is generally ordered between 26° and 30° R. (90½° to 100° F.)

Though in obstinate cases of gout or rheumatism, with great torpor of the vascular system, such heat may afford assistance in the cure, as a general rule it is decidedly objectionable. The increase of pulse ought alone to be sufficient to warn us of the danger to which this practice may lead. The body will certainly bear a little more heat in the mud than in the water bath, because the solid moory mass requires a considerable amount of latent heat to retain its temperature; but if we consider that an increased flow of blood to the chest and brain is primarily encouraged by the compression exercised on the lower part of the body, you must perceive how easily congestion to vital organs may be induced in persons at all inclined to it. It would therefore be greatly advisable to reduce the heat of the mud-baths, and to take the necessary measures for repression of the boasted advantage—which is a great disadvantage in my opinion, as causing increased action of the heart. The apparent anomaly of sulphur and saline baths simultaneously employed requires a few words of further remark. If every disease appeared in a pure and uncomplicated state, such a combination would be worse than useless; but considering the manifold injuries to which our organism is constantly exposed, various diseases may at the same time be produced. We must suppose our organic structures to be engaged in constant struggles with the inanimate substances surrounding us. The oxygen of the air, whilst it maintains the internal process of combustion by its combination with the effete carbon and hydrogen, and thus sustains vitality, sets up the antagonistic chemical action in our system, and will only perform its duty to the determined period without discomfort as long as the organs of reception have not met with any injury. But let any change of structure or of action take place in these organs, and the life-maintaining virtue of air will only hasten the termination of these functions. The digestive canal destined to embrace and elaborate ingredients for the restoration of wasted substances, which have yielded their vitality to the urgent inroads of chemical affinity, is too often called upon to receive substances which, instead of restoring, induce injurious and anti-vital action in the reproductive organs. With regard to the skin, with what admirable wisdom is it spread as a protecting cover over our whole body, designed to prevent any impediment to the necessary movements of the various organic liquids, and to allow egress to such liquid and gaseous particles as have become effete, but have not been removed by the ordinary emunctories of the body. At the same time, it is a guardian of the medium in which we breathe. Its numerous nervous ramifications communicate to the superintending brain the slightest deviation from normal contact. To how many attacks is this covering exposed! Whilst nature permits only a very gradual change of temperature, our civilized habits subject us daily to frequent extremes of heat and cold, rendering the skin more and more susceptible to injurious influences; these dangerous changes are multiplied till repulsion of exhalation and sudden withdrawal of internal heat cause congestion of an internal organ.

The brain, placed at the extreme elevation of our structure, to govern and watch the movements of the subordinate organs, and to perform the higher mental functions peculiar to man, is not unexposed to injury, notwithstanding the out-posts placed there in the shape of senses. The position of the brain shows that nature intended the stimulating and nutrient blood to remain as short a time as possible in contact with the cerebral tissue, for the afflux of the blood is checked by moving upwards, and the reflux facilitated by the force of the fall; the reverse taking place in the abdomen, the chief seat of nutrition and reproduction, and where therefore a comparative greater amount and rather prolonged sojourn of blood are demanded. How often is this arrangement of a wise Creator disregarded, and a prolonged sojourn of blood in the cerebral vessels encouraged by an excessive tasking of the brain for mental work, or by more active congestion induced through excessive indulgence in spirituous liquors, or through overloading the intestinal canal at too late an hour to admit of a proper elaboration, so that obstructed abdominal circulation will not admit the usual share of the moving blood, and induces stagnation or impeded reflux of blood from the brain. If we then admit that most people in a state of health live more in accordance with fancy or convenience than with physiological requirements, and that apparently trifling hints of physical disturbance are disregarded till actual disease appears, which is more the ultimate consequence than the immediate result of the irregularities alluded to, the array of chronic diseases must be looked upon as comparatively small, and the changes which have been brought about very slowly and imperceptibly, require again a long, varied, and persevering employment of counteracting healing agents, till the normal and healthful equilibrium becomes properly reinstated.

We return to Bückeburg, and pass cursorily through the village of *Eilsen*, which lies a league distant, 293 feet above the level of the sea, six leagues to the south-west of Nenndorf, two north of Rinteln, and eight north of Pyrmont. Its bath arrangements, as well as the composition of the water, are analogous to Nenndorf (with, however, more sulphate of lime and of magnesia and sulphuretted hydrogen gas). Though less celebrated, it is more frequented than

Nenndorf.* Then we direct our course to the charming and fertile plain in which lies the village of *Meinberg,* with its cold sulphur springs, four leagues to the south-west of Pyrmont, and one to the north of Horn. We have to cross the Weser, near Rinteln, to proceed direct to Meinberg, or coming from the south by the Deutzminden railroad, we stop at *Bielefeld* station, and drive five leagues eastward. This Spa is distinguished by possessing steel and saline springs, and a great abundance of carbonic acid, besides the cold sulphur spring, which stamp it as a highly efficacious theiokrene. The Teutoburger forest extends in a north-westerly direction past the Spa, causing it to possess an altitude of 634 feet. The battle of Herman, which put a limit to the Roman conquests in Germany, was fought in this neighbourhood. The celebrated rocks of the Externstones are also situated near the Spa. The old drinking-well is remarkable for the number of ingredients (twenty) which are contained in less than six grains of solid residue. The *Neubrunnen,* with 14¾ grains, contains chiefly Glauber and bitter salt. The '*Mineralquelle am Stern,*' more abundant, belongs to the chalybeate springs. The saline springs of *Schieder* arise a league and a half from Meinberg, at the foot of the Essenberg, near the high-road between Wöbbel and Schieder, chloride of sodium (50 grains), sulphate of soda (11) and of lime (13), forming the chief ingredients, with chloride of calcium and carbonate of lime (6 of each), altogether eighty-seven grains. There is also an acidulous spring near the Bollenberg, a league to the south-west of Meinberg. Before I mention the composition of its sulphurous springs in comparison with the other theiokrenæ, I must allude to the mighty evolution of carbonic acid gas taking place with a very considerable tension over the mirror of the Trinkquelle. It is enclosed by an amphitheatre-like building, and provided with benches and seats for patients requiring gas-baths. The tension of the gas is so powerful here, that when the new well was deepened in 1801, the carbonic acid rose in a stream 7½ inches thick to a height of twenty-seven feet above the borehole, which reached to a depth of seventy-two feet. It hurled stones as large as the fist into the air, and the workmen escaped with the greatest difficulty the danger of suffocation. The gas came out of a depth of 451 feet. The distinguishing strong tension of the carbonic acid, containing a considerable proportion of sulphuretted hydrogen, prevents its mixing so rapidly with the atmospheric air, and affords therefore more potent gas-baths than even Pyrmont. This strong tension permits the preparation of the so-called 'Sprudel' baths, which become undulated by a stream of carbonic acid violently rushing through a tap to the amount of 1½ cubic feet per minute. They are often resorted to with great advantage as an after-cure, following the course of the sulphur mud-baths, and obviating the susceptibility and weakness of the skin that might in some instances result from a necessary lengthy employment of sulphur mud-baths.

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* For the analysis of Eilsen water, see the table of sulphurous springs at the end. A detailed description seemed unnecessary, from its great similarity to Nenndorf. The physicians of Eilsen are Drs. v. Möllar, Maier, and Weiss.

The curative agents of Meinberg are multifarious. It possesses chalybeate, sulphurous, saline, and acidulous springs, with sulphur mud-baths (resembling those of Eilsen), and its distinguishing local and general carbonic acid gas-baths. These are very extensively employed, and are considered as specially sanative in catamenial anomalies, leucorrhœa, chlorosis, hysteria, spasms, great weakness of the cutaneous system, pulmonary blennorrhages, &c. In chronic inflammation of the tonsils or uvula, in affections of the meatus auditorius, &c., very happy results from local gas-baths are recorded by Dr. Piderit. Neuralgia of the facial nerves, ozæna, sexual torpor, &c.; in short, where utility may be expected from carbonic acid gas, Meinberg is especially indicated. The adjoining table will further illustrate the variety of remedial means offered by Meinberg:—

Contents of the Meinberg springs.

	Trinkq.	Neubrunn.	Quelle im Stern.	Schwefel-quelle.	Koch-salzq.	Acidulous spring, near the Bellenberg.
Temperature	6° 10 R.	—	—	7° 5	8° 9	
Carbonic acid	34·36 cub. in.		1·83	2·12	9·74	18·49
Sulph. hydrog.	—	—	—	0·55		
Nitrogen	0·14					
Total solid residue	5·96	14·73	23·36	19·48	78·44	7·57
Sulphate of soda	1·15	4·51	1·34	5·84	11·01	
„ magnes.	1·14	2·52	3·67	1·73	—	0·04
„ lime	0·28	3·45	15·16	8·33	13·46	0·18
Chloride of sodium	—	—	—	—	40·95	0·07
„ magnes.	0·81	0·98	0·24	1·03	6·31	0·14
Carbonate of lime	1·45	2·65	1·17	2·14	6·03	5·02
„ magnes.	0·15	0·24	0·17	0·17	0·51	2·04
„ iron	0·08	0·07	0·01	0·008	0·07	0·005
Silica	0·06	0·25	0·08	0·12	0·00	0·05
Extractive substance	0·57					

Now, Gentlemen, you must accompany me to some distance again, before we visit the next Westphalian Spa. I wish to direct your attention to the theiotherma (hot sulphurous spring) of *Aix-la-Chapelle* (*Aachen*, in German), the first German town you passed when travelling from England, to visit the distant Spas. When you landed at Ostend, the railroad which brings the sea-shore in connexion with the Rhine at Cologne, passes Aix-la-Chapelle, so that from London you may reach this celebrated and formerly imperial town in less than twenty-four hours. It will be the last sulphur spring I shall submit to your consideration, but not the least, as you will perceive from its description. It lies in a pleasant valley between the Rhine and the Maas rivers, 450 feet above the level of the sea, fifteen leagues from the north-eastern town of Cologne, nine from Liége (south-west), ten from Spa (southward); at a latitude of 50¾° and east longitude of 6°. The warm springs are said to have been discovered, fifty-three years after Christ, by a Roman of the name of Granus; others were induced by him to reside there, so that a small town was founded, which was afterwards destroyed by the Huns under Attila, in 451. The Latin name of Aquisgranum is said to be derived from this first discoverer. The Romans had settled between the Maas and the Rhine when at war with the Germans. Bonn, Cologne, Düren, Jülich, &c., owe their origin to them. Roman coins were often found in cleaning the Kaiserbrunnen. The famous *Charlemagne*, in the year 777, first re-discovered, while hunting, the hot springs and bath ruins, left from the time of the Romans, and was induced by the beautiful environs to build a castle and church there, to reconstruct the baths, and to choose the place for his residence. He declared Aix-la-Chapelle the second town of his immense empire, and the capital of Germany and France, and died there in the year 814, at the age of seventy-two. The German emperors were crowned there for a long time. In the twelfth century the town was so flourishing, and its population so rapidly increasing, that a new town grew up beyond the gates of the old one. Five hundred years ago, the town numbered 100,000 inhabitants. It has, however, suffered from extensive conflagrations several times, and on the last occasion (1656), nearly the whole town was destroyed, with all the worldly goods of the citizens. From this damage they never recovered. Another great loss had just previously been sustained by the emigration of wealthy and skilful Protestants, in consequence of the persecution to which they had been exposed. When under French government, Aix was very prosperous. In 1818, the congress of monarchs was held within its walls. It belongs at present to Prussia, is the capital of the regency of Aachen, and possesses 46,000 inhabitants, and several very fine buildings, as the theatre, built in 1825, the beautiful enclosure of the Elisenbrunnen, the new Regency building, and many extensive cloth and needle manufactories. The whole town is pleasantly situated near the Eifel mountain, and is chiefly ancient, with the exception of that part situated between the theatre and the station of the Rhenish railroad, to the south of the town, which contains modern buildings of very fine exterior. The town has a pleasing open appearance, the streets being wide, and the houses only of a moderate height. In the centre of the town, on its highest point, is the large market-place, opposite the antique town-house, with its two lateral towers, one of which (Granusthurm) is ascribed to Roman origin. The palace of Charlemagne is said to have stood here, and to have extended as far as the 'Kaiser-bad' and the Münsterchurch. His fondness for warm-baths, which induced him to choose Aachen for his permanent residence, renders this probable. Towards the year 800, he built a cathedral church, and had the marble brought from Rome and Ravenna, and the flagstones from Verdun. Eight pillars supported the temple, and between them stood thirty-two Corinthian columns, partly composed of granite, partly of marble, two of green porphyry. These two were broken by the French in the war of the revolution, but they were subsequently restored. This superb church was considerably injured by the Normans in 882, but subsequently repaired. The tomb of Charlemagne is shown in the middle of the old dome, with the simple inscription—'Carolo magno.' His skull, ivory hunting horn, and many other relics are preserved there, and shown to the people every seven years, causing thousands of pilgrims to migrate thither and satisfy their religious curiosity.

The environs of Aix-la-Chapelle are mountainous, with cultivated declivities. The mountains are but of a moderate height, and form only a partial limitation to the openness of the country. The Luisberg rises to the north of the town, and affords charming views from its eminence. To the south, woody and less fertile regions adjoin, extending westward into the Ardennen, eastward into the Eifel mountain. Towards the north-east, the ground becomes flatter and abounds in corn. The soil of the immediate environs is siliceous, calcareous, or sandy, and in some places as fine as sea-sand. Sulphur-pyrites is frequently found. Pit coal is also dug up in the neighbourhood and used for fuel. Calamine is another production of the environs. At some greater distance from the town, lead and iron mines and limestone quarries exist, besides several kinds of clay-earths used for various manufacturing purposes.

The foundation of the Aachen mountains consists of transition limestone. This is superposed by grey sandstone, intermixed with glimmer, and in some places substituted by strata of coal or clay-slate. The position of Aix-la-Chapelle, and the numerous shady walks, with picturesque country-seats, and farms, and alternating hills and valleys, render it a very agreeable resort. Amongst the varied walks, that which leads to the summit of the Luisberg is the most charming, and repays one with a picturesque view of the town and its environs. The eye has a wider scope towards the north and east than towards the south and west. It was only with great difficulty that this barren mountain could be ascended formerly, but it is now laid out in the style of a so-called English garden, and easy of access by well arranged roads. A Belvidere and saloon for company often receive visits from the residents and strangers. A pyramid of hewn stones adorns the apex. It was erected in 1807 to the memory of Tronchot and his astronomical labours performed there. The thermal springs are divided into upper (warmer) and lower (less warm). The chief spring, *Kaiserquelle* (emperor's spring), has the highest temperature, and contains the greatest proportion of solid ingredients. It supplies the *Elisenbrunnen* (the drinking fountain), the Kaiser-bad, the new bath, and the bath of the Königin von Ungarn; the thermal springs before the Kaiserbad, on the Büchel, have the same temperature as the former (46° R. = 135½° F.).

The lower sulphur springs are the Corneliusquelle (with 37° R.), the spring of the old drinking-well (35° R.), and the Rosenbadquelle (37° R.) The springs are all surrounded with bath establishments, where the visitors find accommodation for residing and bathing.

The Kaiserquelle arises nearly in the centre of the town out of several fissures in the rock. It lies as it were at the foot of an eminence, which reaches its highest point on the market-place. The lower springs lie at about 400 yards distance, in a less elevated position. The springs come to light between strata of transition-limestone and sandstone with glimmer.

The water is clear and transparent, but has a strong sulphurous smell and taste. The constituents of the various springs are nearly the same; the temperature, however, varies, and the amount of sulphuretted hydrogen decreases with the diminution of heat in the respective springs. This is at once a demonstration of the fact, that the sulphuretted hydrogen gas is not evolved from the depth to mingle with the mineral water, as is the case with carbonic acid, for then the colder the spring the greater would be the amount of gas; but on the contrary, it diminishes with the proportion of glairine, which is smaller in the less warm springs. The amount of this substance is 0·29 in the Kaiserquelle, 0·28 in the Quirinusquelle, 0·27 in the Rosenbadquelle, 0·19 in the Corneliusquelle. The sulphuretted hydrogen is thus supposed to be due to organic decomposition. Under the influence of heat the glairine enters into chemical action with the sulphate of soda, deoxidising the two component parts and transforming them into sulphuret of sodium. The carbonic acid evolved during the process, tending to combine with sodium, induces this substance to attract oxygen by the decomposition of the water. The disengaged sulphur then combines with the hydrogen of the water, and thus sulphuretted hydrogen results. The sulphuret of sodium discovered in analysis may be the product of the above process. Thus the greater the heat, the more intense the chemical action and the production of sulphuretted hydrogen. The vapours of the springs are employed for vapour-baths; douches are likewise administered with various force, and very judiciously assisted by friction and champooing.

The analysis of the chief source (Kaiserquelle) shows 31·9 grains of solid and 26½ cubic inches of gaseous constituents; temperature 46° R. = 135½° F.—viz.:

20·71	chloride of sodium.
6·61	carbonate of soda.
0·23	,, lime.
0·15	,, magnesia.
0·04	,, strontia.
2·12	sulphate of soda.
0·62	sulphuret of sodium.
0·14	phosphate of soda.
0·47	fluoride of calcium.
0·29	animal organic substance.
0·54	silica.
31·95	grains in 16 ounces.

GASEOUS CONTENTS.

8·	cubic inches of carbonic acid.
18·53	,, nitrogen.
0·13	,, sulphuretted hydrogen.
26·66	cubic inches.

Quirinusquelle possesses 31·08 grains of solid constituents, with a temperature of 38° R. The Corneliusquelle $29\frac{3}{4}$ grains and a temperature of 37° R.; the Rosenbadquelle 29·63 grains, with 37° R.=$115\frac{1}{4}$° F.

However inconsiderable the amount of sulphuretted hydrogen may appear (less than the fifth of a cubic inch), sulphur deposits itself on the covers of the baignoirs, and in all those spots exposed to the rising vapour. At first this covering resembles fine snow, with minute shining crystals. Gradually the first laminæ condense, but remain soft and pappy as long as additional vapours increase their volume, but removed and exposed to the air they become yellowish and hard. The thermal salt obtained by evaporation of the water contains, in 100 parts, 64·84 chloride of sodium, 20·68 carbonate of soda, 0·72 carbonate of lime, 0·47 of magnesia, 0·13 of strontia, 8·57 sulphate of soda, 0·44 phosphate of soda, 1·50 fluoride of calcium, and 1·68 silica.

The sulphuretted gas was formerly thought to be combined in this Spa with nitrogen, instead of with hydrogen. But this turned out a fallacy, and it is now considered as sulphuretted hydrogen mixed with a considerable amount of nitrogen, greatly surpassing in this respect all other sulphur springs.

If you compare the contents of the Aix-la-Chapelle water with those of other theiopegæ, you will at once perceive the necessity for careful discrimination. In recommending *Nenndorf,* for instance, your patient will imbibe a greater amount of hydrothionic acid, it is true; but whilst sodium and soda form the chief bases here, you have calcium and lime as the prominent bases there. Chloride of sodium forming two-thirds of the solid contents, and carbonate of soda one-fifth, you have, properly speaking, a saline water before you, modified by the presence of neutral salts and distinguished by sulphuretted hydrogen and a great quantity of nitrogen. That it must be better tolerated by the intestinal tube can admit of no doubt.

I must direct your attention to the circumstance, that (with the exception of the sulphuretted hydrogen) the akratotherma of *Wildbad* (in Würtemberg) contains the same ingredients in the same relative proportions, though in considerably less quantity. You find there chloride of sodium as the chief ingredient, carbonate of soda as the next in amount, and sulphate of soda as the third. If the facts recorded of the peculiar effect of Aix-la-Chapelle bear a striking analogy to those witnessed in Wildbad (where also nitrogen is the preponderating gas), you may consider it as an additional confirmatory evidence of the views I ventured to express concerning the operation of the Wildbad water. Compare Aix-la-Chapelle with *Weilbach,* and a very different result again is observed. You have only a trace of nitrogen, a greater amount of sulphuretted hydrogen, and as the chief ingredient neither chloride of sodium nor sulphate of lime, but carbonate of soda, with carbonate of magnesia as the next, and carbonate of lime as the third important ingredient. It bears therefore more chemical analogy to Teplitz. The contrast of temperature and the quantity of distinguishing sulphuretted hydrogen gas terminates the parallel by a broad distinction.

Baden, near Vienna, offers more resemblance to Nenndorf, in a chemical point of view, than to Aix-la-Chapelle, with the difference, however, that though sulphate of lime forms its chief constituent, and carbonate of lime the next, every ingredient exists in a smaller quantity, whilst the irritating lime-salts are more than counterbalanced by the presence of gently solvent and aperient salts, as sulphate of soda and magnesia with chloride of sodium. These considerations will guide you in your choice, and at the same time inform you of the peculiarity of our present spa. The action of Aix-la-Chapelle water is chiefly displayed in chronic diseases of the skin, in suddenly suppressed itch, tetter, in chronic rheumatism and gout, contractions of the joints with swelling, in acidity, flatulence, menstrual colic, lithiasis, hydrargyrosis, paralysis from metastasis, &c. It is contra-indicated in great weakness, tendency to congestion, to active hæmorrhage, &c. The water is allowed to flow into a reservoir, and not employed for bathing till it has acquired the proper temperature, which ought never to exceed 95° F., but should rather be below this heat. The frictions connected here with the douche-baths and the wel contrived vapour-baths contribute not a little to the success so frequently observed at Aix-la-Chapelle in obstinate cases of rheumatism or gout, in which other spas have failed. In contractions from chronic gout and rheumatism Aix-la-Chapelle has shown itself particularly efficacious, according to Drs. Zitterland, Velten, and Stretter, &c. While rubbing the patient, the frotteur breaks the force of the douche with his hand. In chronic diseases of the liver the action of the water is sometimes assisted by adding Carlsbad salt. According to Dr. Wetzlar, the water acts specifically in all diseases arising from abuse of mercury, or from individual carelessness during its proper employment. Several cases of tertiary and secondary syphilis degenerated by excessive mercurials are so far assisted by the Spa that the mercury becomes eliminated and its effects removed, so that the uncomplicated syphilis will then yield to ordinary treatment. Iodide of potassium, or decoct. Zittmanni (in more obstinate cases), have then often cured non-Hunterian syphilitic ulcers, when the same remedies had been ineffectually employed before. In chronic poisoning by lead or arsenic, the Spa is equally useful. As a proof of the utility of Aix-la-Chapelle in herpetic metastases the case of a lady is mentioned, sent by Professor Andral from Paris. She suffered from symptoms of gastric inflammation, in consequence of a previous 'dartre.' Dr. Wetzlar employed the water with reluctance, as it invariably increases previously existing intestinal irritation. In deference, however, to the high authority of Andral, he administered it, and found the vomiting, pain, &c., disappear as if by enchantment, and after four weeks complete success confirmed the acumen of Andral. Slight prurigo showed itself during the course, but disappeared spontaneously. Erethic scrofula is sometimes relieved by the water. Regular gout is not cured there, but anomalous, wandering, and especially metastatic or metaschematic gout, is cured. Count Lubienski presented himself in 1846 with the symptoms of apparent valvular disease of the heart. Dr. Hederus, of Dresden, however, ascribing the disease to arthritic diathesis, recommended Aix-la-Chapelle. In this instance also cure ensued, notwithstanding the apparently contra-indicating phenomena. In hæmorrhoidal congestion, or otherwise obstructed portal circulation, the Elisabethquelle, with the addition of sulphate of soda, exhibits highly curative results. You see then that hæmorrhoids, which form such a prevailing indication for Weilbach, are here only enumerated as of secondary consideration. The circumstances mentioned point to the fact, that among all the theiopegæ treated of, Weilbach is the only one where the sanative influence consists chiefly in the internal employment of the water, whilst the agency of heat, the force of the douche, the very skilful and judicious kneading and rubbing of affected parts, form a powerful assistance here. The great advantage of proximity, enjoyed by Aachen, is in some measure counterbalanced by the less sociable habits of the valetudinarians, who are dispersed in the several hotels and private houses of the town. The association of the Cursaal and bath-houses with adjoining extensive walks into the open fields of rural spas, is missing here, so that the visitor finds too much analogy to the commercial bustle at home to lead the tranquil life required. This must not be taken as depreciating the value of the Spa, for when indicated, it cannot be substituted by another, as I have shown by its complete distinction from waters belonging to the same class. But it is important to direct your patient's attention to this circumstance, and to request him not to live in Aix-la-Chapelle as he would in a place requiring his presence for business purposes. He should not indulge in a secluded mode of living, or take his meals in a private room, brooding over his affairs in a box of an elegant coffee-room. You must remind him of the necessity of muscular exercise in the free air, not only for a proper elaboration of the water, and for inhalation of a purer air, but for greater exhilaration of his spirits. Vastness of extent must permit a distant range to his sight, he must feel free in mind and body, if he wishes to reap the utmost benefit from his compulsory separation from the objects of his attachment and care. Cheerful society and unrestrained intercourse with strangers engaged in the same pursuit eases the mind, and makes the blood circulate more briskly through its accustomed channels.

The very great influence of the mind on the body has been lately demonstrated in a highly interesting clinical lecture by Mr. Solly, of St. Thomas's Hospital, '*On purulent absorption.*'—(*Lancet*, March 15, 1851). After premising that there has been a great tendency lately to a low form of gangrenous erysipelas, to carbuncles, and to unhealthy inflammations generally, to which several patients succumbed after trifling operations, he alludes to the observation, that when the vital forces retain their normal power, pus mixed with the blood coagulates that fluid, and the wound in the vessel is sealed by a firm coagulum of blood, while the healing process is going on; but if the vital power of the blood is diminished by disease, then this conservative coagulating action does not take place in time to plug the vessel and stop the poison at the threshold. The barrier which nature in a state of health erects to prevent the flow of pus into the veins, is not set up, and the poisonous fluid is carried onward in the current of the circulation. After explaining how this barrier is not only interfered with by disease, but how it is sometimes broken down mechanically, if the limb is not kept at rest, so that the plug is not formed, and phlebitis induced by the generation of pus, he proceeds: 'There is another depressing agent, which I think has not been sufficiently insisted upon: I mean anxiety of mind. I am quite sure that mental anxiety has carried more poor fellows to the grave than any single cause that the surgeon has to contend with. I have repeatedly and for a long series of years, observed a connexion between anxiety of mind and the formation of abscesses. I have also observed purulent absorption more frequent in patients who, to use their own phrase, have had 'something on their minds.' This was certainly the case in the instance of two of the patients to whom I have adverted.'

However remarkable such an observation may be, it ought not to surprise us. For do we not see the best appetite or hunger suddenly checked or destroyed by the occurrence of sorrow or fear? Hilarity must be considered as a complete equilibrium of the mental state. The brain possesses therefore the greatest power, and imparts it by the nerves to the abdominal organs. Reparation of wasted substance proceeds vigorously, the necessary biliary and pancreatic liquids are added in proper time; healthy blood results and provides the brain with a wholesome stimulus and nutriment. When care or sorrow, however, finds entrance into the mind, and the central power is suddenly depressed, the dependent abdominal nerves are unable to stimulate their subordinate muscles to the required motion. The contractions are therefore more feeble, the gastric juice less solvent, the admixture of digestive liquids less abundant or less timely, the separation of chyle from saburra less complete; hence absorption of bile into the blood, which becomes vitiated and feeble, and reacts again as an unfavourable stimulus on the brain, increasing the former evil. From this the popular but judicious rule, not to eat in anger or grief, and to enjoy cheerful conversation during meals.

The cold chalybeate springs found at Aix-la-Chapelle are occasionally used as an after-cure, but they are of too little importance to require a detailed description. The one contains half, the other three-quarters of a grain of iron in sixteen ounces, no sulphuretted hydrogen, but some carbonic acid, besides other ingredients contained in the sulphur springs.

A very short distance to the south of Aix-la-Chapelle, on the declivity of a steep hill, is situated *Burtscheid* (*Borcette*). The upper (warmer) springs contain no sulphuretted hydrogen; the lower (cooler) do. In other respects, their contents are analogous to those of Aachen. One of the upper sources is the hottest in Germany, viz., the *Mühlenbadquelle*, which has a temperature of 62° Reaumur = 171½° Fahrenheit. The others have respectively, 48°, 47°, 35° Reaumur. The promenade from Aachen to the drinking well of Burtscheid is very pleasant. The Burtscheid waters are often used, alternately or conjointly, with those of Aix-la-Chapelle.

LECTURE XVI.

PYRMONT.—DRIBURG.—SCHWALBACH.—SPAA.

GENTLEMEN,—After our deviation from Westphalia, we return to seek the celebrated chalybeate spring of Pyrmont. We might travel southward through Hameln, or if coming from London, we alight at the Herford station, on the Deutz-Minden railroad, and then proceed by the diligence through Uffeln, Lemgo, &c., to Pyrmont. The diligence generally starts at 4½ P.M., and performs the distance of seven German miles (about thirty-five English) in seven hours. Herford station precedes the new saline spring of *Oeynhausen*, near the Rehme station, of which I shall treat on another occasion. Before, however, we enter into a description of the Westphalian chalybokrene, let us consider the properties of chalybeate springs in general.

The steel-springs, chalybokrenæ, (from *χάλυψ*, steel, and *κρήνη*, cold spring,) contain an excess of carbonic acid, which keeps the carbonate of protoxide of iron in solution. Whilst a small amount of iron is contained in most springs, those belonging to our present class possess the carbonate of iron as a predominating ingredient, either in a larger proportion or in the absence of other powerful constituents. The iron generally prevents too lowering an effect being produced by other weakening ingredients; as, for instance, alkaline, saline, bitter-waters, &c., would produce too great atony of the intestinal mucous membrane, by constant provocation. and stimulation of peristaltic action, the necessary secretive and assimilative processes would be carried on with deficient tone and vigour, if the corrective presence of iron did not counteract this antiplastic tendency. The advantage of such a combination is frequently experienced by the ordinary administration of aperient extracts with lactate or sulphate of iron in the instance of chlorotic females, or of anæmic patients of our sex, especially if this sanguineous deficiency results from a lengthened sojourn in a tropical climate, as is shown by the admirable writings of Mr. J. R. Martin. When iron forms the prevailing ingredient, it increases the plastic and stimulating tendency of the blood to a high degree, and enables it to perform its multifarious functions with vigour. It appears that the less firm the attachment of the iron to its acid or halogen, the more readily it is assimilated. Thus, whilst sulphate of iron, for instance, might be supposed to permeate more easily into the circulating channels from its greater solubility, we may expect that the less soluble carbonate of iron may more readily allow decomposition for chemico-vital combinations, when brought into contact with the blood in such a highly-dissolved state (through the excess of carbonic acid). And if we prefer sulphate of iron in pharmaceutic preparations, it is because we cannot introduce the carbonate with the diluting volatile gas. But in ferruginous mineral waters, where the carbonates are absorbed with the same facility as the sulphates are, this distinction may be clearly drawn. The non-carbonates seem to require more elaboration before they are allowed to mingle with the blood-globules. For their administration, stronger and less irritable digestive organs are required, as the vital heat seems first necessary to deoxidise the compounds, and then to separate the two elements before the iron can attach itself to the organic liquid.

If any tendency to congestion or inflammation exists, iron is of course contra-indicated, as it would increase this morbid disposition. The great importance of iron has been so ably demonstrated by the above authority (Mr. Martin) who, when treating of tropical influence on Europeans, traced the petulance and peevishness of temper, the forgetfulness, inaptitude both for business and recreation, the headache, restlessness, anorexia, alvine obstruction,—and even pain and stitches in the right hypochondriac region, with an accelerated but feeble pulse, and symptoms simulating hepatic affection,—to an absence of the necessary proportion of iron in the blood, which had lost too much of its serum through the lengthened influence of the tropical sun, so that the over-stimulated liver, kidneys, and skin, lay in a comparative state of prostration. Apparent inflammatory phenomena were cured in such invalids, not by depletion, or weakening measures, but his '*acute anæmia*' was cured in many seemingly hopeless cases by steel, of course with proper regard to the function of the skin and abdominal organs. The additional light thrown on the nature of these diseases, and the almost certain relief procured by iron and other tonics, ought to induce us to regard with a particularly favourable eye the chalybeate springs which I am about to submit to your notice.

The town of *Pyrmont* is situated at an altitude of 404 feet above the level of the sea, latitude 52° east, longitude 9°, in the principality of Waldeck, on the left bank of the Weser. It is fourteen leagues distant from Hanover, three from Hameln, four and a quarter from Lemgo, six and a quarter from Bückeburg, seven from Eilsen, and seven and three-quarters from Minden. The valley in which the springs arise, within and near the town, is very fertile and abundantly provided with corn fields, whilst shady walks intersect the arable land. The environs witnessed the exploits of Arminius, Prince of the Cheruskians, and subsequently the battles fought between Charlemagne and the Saxons. The chief spring was formerly denominated the 'hylige Born' (fons sacer), and its immediate circuit the 'heilige Anger.' Though known from great antiquity, their reputation dates from the sixteenth century, especially after the termination of the thirty years' war. Upwards of 10,000 visitors are said to have resorted to the Spa within four weeks, over-crowding all the adjoining villages and woods. The water was put into tubs and sent to the expectant valetudinarians around the neighbourhood. In 1681 more than forty royal and princely personages were enumerated amongst the visitors.

Great luxury and convenience distinguish the baths and habitations. Numerous spots in the picturesque environs invite the visitors, as the Mühlenberg, Hünenburg, Gravingsberg, wilde Schellenberg, with the ruins of Schell-Pyrmont, &c. The earth-falls near Holzhausen, a short distance from Pyrmont, are very remarkable. But the most curious phenomenon remains to be named—viz., the *vapour-cave* to the north-east of Pyrmont, where a constant evolution of carbonic acid gas takes place, forming a permanent layer of from two to eight feet above the ground, mixed with some atmospheric air and a very small amount of sulphuretted hydrogen gas. According to Humboldt, 100 parts consist of 86·66 of air and 13·33 of carbonic acid. The cave resembles the grotto del Cane near Naples, but the deviation of the magnetic needle, observed there, was not noticed here. The layer of gas is smallest in winter and highest in summer, just before the appearance of a tempest. Generally in summer the layer is more extensive immediately after sunrise and sunset, diminishing gradually as the rays of the sun assume more power. The mountains consist of stratified layers and alluvial land. Red sandstone forms the foundation, superposed and surrounded by marl, shell-lime, with the addition of alluvial layers of sand, clay, &c., whilst granite blocks are sparingly met with here and there. Basalt is found about thirty miles from Pyrmont. The ferruginous drinking spring (*eisenhaltige Trinkquelle*) arises in variegated sandstone at the beginning of the grand promenade of ancient lime-trees. The water is clear and sparkling; in taste, agreeably acidulous, and leaves an astringent sensation on the palate. The smell offers nothing peculiar, with the exception of an occasional odour of sulphuretted hydrogen over the surface of the water. Exposed to the air, a brownish deposit of oxide of iron is soon formed, with some manganese and lime. Its temperature amounts to 10° R.$=54\frac{1}{2}$° F.; its specific gravity to 1·005; and its supply to 22 pounds per minute. It contains $44\frac{1}{2}$ cubic inches of carbonic acid, and above 28 grains of solid ingredients in 16 ounces; sulphate of lime forming the prominent substance (nine grains), carbonate of lime the next (nearly six grains), about ten of sulphate of magnesia and of soda, and nearly half a grain of iron (0·49).

The *Badequelle,* or Brodelbrunnen (fons bulliens), resembles the former, from which it is only a few steps distant. The water is more sparkling, and has a layer of eighteen inches of carbonic gas over its mirror. Carbonic acid and iron are both intimately and firmly united with the water. A bath, tested after having been used three-quarters of an hour, possessed fourteen cubic inches of carbonic acid in 13·6 of water, and when filtered the presence of iron was demonstrated by ferrocyanide of potassium and tincture of galls. The *Augenbrunnen* (eye-well), fifty-eight feet to the west of the Trinkquelle, arises out of white clay, analogous in its proportions to the former, but only used externally as a cooling and astringent remedy in certain ophthalmic blennorrhages, &c. The *Neubrunnen* (new spring) issues out of variegated ferruginous sandstone on a meadow near the Emmer, and is very analogous to the drinking well.

But besides the above chalybeates, Pyrmont possesses saline springs: the *Soolquelle* originates half a league from Pyrmont, not far from the Emmer, in the deepest part of the valley, in variegated sandstone. Its taste is saline-bitterish, its temperature $8\frac{3}{4}^\circ$ R. *The muriatico-saline drinking well* is clear, strongly sparkling, of a marked saline-bitterish taste, inodorous, specific gravity 1·011; temperature 8° 8′ R. Besides these, an acidulous spring is found there, clear, transparent, and sparkling, with a piquant taste.

Contents of the chief Pyrmont Springs.

	Trinkq.	Brodel-brunnen.	Augenq.	Neubr.	Soolq.	Mur.sal.q.	Säuer-ling.
Sulphate of lime	7·22 gr.	6·07	4·10	—	14·58	5·51	0·31
„ magnes.	2·69	5·53	4·56	3·47	2·33	—	0·60
„ soda	2·14	—	1·71	7·34	5·29	12·24	0·37
Carbonate of lime	5·98	4·52	3·81	7·86	2·71	6·92	1·81
„ magnes.	0·32	0·24	0·25	0·96	0·46	—	0·16
„ soda	—	4·78	0·84	2·62	1·49	6·23	0·30
„ iron	0 49	0·58	0·13	0·75	0·08	0·06	—
Chloride of sodium	—	—	0·44	4·38	61·68	65·49	0·01
„ magnes.	1·12	1·48	0·45	0 97	6 92	12·07	0·12
Silica	0·49	0·25	0·10	0·20	—	—	—
Total	20·02	23·62	16·46	28·98	95·32	108·7	3·72
	cubic in.						
Carbonic acid	44·52	38·51	36·28	39·28	17·46	26·19	21·84
Sulphur. hydrogen	—	—	0·39	—	—	—	—

Temperature........ 8° 8 to 10° R. From $51\frac{3}{4}^\circ$ to $54\frac{1}{2}^\circ$ F.

The effect of Pyrmont is chiefly displayed in *real debility*, whether produced by exhaustion of vital power, or by deficient nutrition, debilitating hæmorrhage, severe acute diseases, and too frequent child-bearing, &c.; in short, it is a most powerful restorative, whenever a great amount of blood or serum has been lost out of its ordinary receptacle, or when the plastic sphere is originally too weak to engender a sufficient amount of cruor for the performance of the necessary vital functions, as in chlorosis, anæmia, hysteria, &c. You cannot repair the deficiency by the food alone, for though you may favour a more energetic sanguification by a liberal diet, you have always to remember that the very weakness of the blood causes a corresponding debility of the digestive organs, so that the more repairing particles the blood claims from the gastric purveyor, the less can be elaborated by that power. Hence we must call medicines to our aid, by which we may strengthen the digestive function, and at the same time supply the want of a certain material in a ready form for immediate assimilation. The great quantity of carbonic acid which introduces the solid particles into the circulating fluids, causes them to be easily distributed and mixed with the existing constituents. More value should be attached to the half-grain of iron imbibed than you could expect from the same quantity of pharmaceutic iron, for, as I stated on a previous occasion, the latter would require elaboration in the intestinal canal before it could enter the blood, consequently it might contribute a much smaller share for reproduction. For we cannot dictate to our prescribed dose to mix entirely with the chyle, and to abstain from yielding any portion to excrementitious matter. Besides, the carbonic acid has the further influence of rousing the torpor of the languidly moving mass, and thus it both brings a needed substance and stimulates to its immediate elaboration and absorption, inevitably increasing metamorphosis. If the action is once commenced, nature does not stand still again. All we have to do in many instances is to give the *vis medicatrix naturæ* a slight spur, or to remove impediments to the development of its action, otherwise it would be absolutely inexplicable, how Hufeland could extol the virtues of this Spa as the sovereign remedy in all cases of real debility and anæmia. 'Whoever does not believe in the efficacy of mineral water,' he says, 'let him come to Pyrmont and witness the wonderful effects produced by this admirable gift of Providence.' Whenever an individual appears pale, of phlegmatic temperament, of a soft, lax fibre, of puffed-up and flabby appearance, the more he is inclined to passive profluvia, to mucosity, the better Pyrmont will agree with him. But if he looks strong, muscular, dark of complexion, if his skin and fibre be dry, tense, if he is more disposed to congestion or active hæmorrhage, Pyrmont and other chalybeates are inapplicable. In most obstinate cases of passive metrorrhage and hæmorrhoidal bleeding, Hufeland witnessed cures effected by Pyrmont, after the useless employment of pharmaceutic tonics and astringents for years, and after the patients had been reduced to a state of deep-seated cachexia and anæmia. But before resorting to Pyrmont in such cases, it is always necessary to examine the phenomena carefully, and to convince ourselves of the presence of *systemic atony*. For should the hæmorrhage be active, or should vascular plethora or general irritability be present, the Spa would be highly injurious. The circulating force of the blood would be increased, and with it the hæmorrhage. Besides, alvine obstruction might be induced at the same time, and the general irritability augment in consequence. We must also inquire whether some local irritation be not the cause of the recurring profluvium, as induration of the organ or other local degenerations. In this case too Pyrmont would be improper. *Difficult menstruation,* accompanied by colic, vomiting, headache, fainting, spasms, &c., is generally cured or relieved here; as also *fluor albus,* based on an atonic state of the generative organs. *Sterility,* unconnected with organic impediments, forms an important indication for the Spa. But the remedial agent must be perseveringly continued for a longer period than usual. Analogous to difficult menstruation, the uterus sometimes induces a great number of abnormal functions by its rebellious reaction after conception, so that a state of ill health continues during the whole term of pregnancy, and disappears after delivery. Dr. Hufeland mentions the instance of a person who married before her complete bodily development. The uterus having been unable to bear the work of regeneration, feverish erethism, emaciation, colic, headache, stupefaction, constant sleepiness, &c., accompanied her during the whole nine months. At one time the weakness and emaciation reached an alarming extent. But after delivery, to the surprise of all, complete restoration took place spontaneously. Dr. Hufeland then, considering the undeveloped and unstable condition of the womb as the sole cause of the array of morbid phenomena, ordered Pyrmont water to be drunk the first year at home, and the next year (during pregnancy*) at the spring. He had the satisfaction of seeing not only this pregnancy run its ordinary course without the former distressing symptoms, but also the next, two years subsequently. But baths and injections (with care) should accompany the internal course.

The tendency to abortion likewise belongs to the class of diseases in which Pyrmont shows itself highly curative. The convulsibility of the womb, which disposes it to contract and expel the fœtus prematurely, is generally due to atonic irritability of the organ. This is powerfully counteracted by the use of Pyrmont, of course whilst the organ is free. *Nervous hypochondriasis and hysteria,* resulting from real defect of nervous power, from exhausting diseases, loss of blood, over-exertion, &c., find an excellent remedy in Pyrmont. But should there be a material basis, as abdominal infarcta, &c., Pyrmont would be injurious by increasing the morbific cause. *In nervous spasms of the stomach,* Pyrmont frequently induced cure or relief; also in nervous vertigo; no improvement however followed in epilepsy. But in paralytic diseases, connected with general weakness, Pyrmont has been found a powerful remedy. It is also useful in chronic diarrhœa, mucous hæmorrhoids, tendency to helminthiasis, &c. In vesical catarrh and seminal weakness it is likewise highly recommended. Hufeland saw nervous amblyopia, muscæ volantes, &c., frequently cured by the external application of the Augenquelle, with the internal use of the water. The saline springs of Pyrmont find their indication in many complaints where a cooling, solvent, and antidyscrasic remedy is required, and are often used with great advantage as a preparatory course before the employment of the chalybeate. Though numerous diseases are mentioned as indications for Pyrmont, they are all ramifications, diverging from the same central cause. If the nervous power be originally exhausted, the contractions of the heart become enfeebled, the peripheric vessels distribute the blood more slowly, regeneration proceeds more tardily, secretions are performed less promptly; chylification and sanguification therefore suffer. Deficient blood-krasis will then increase the original nervous weakness. Or if the cause of debility proceed from unusually excessive secretions, the result will exhibit the same phenomena. Whether the blood be propelled with less force, or whether it be deficient in its required consistency, the consequence must be diminished stimulation of the recipient organs. This state then is rationally and practically counteracted by Pyrmont. But you have to bear in mind that when the Spa cures diarrhœa, excessive mucosity of the alimentary canal, &c., we must attribute this effect partly to the increased tone of the fibre, and partly to the absorbent power of the lime (nearly two-thirds of the solid ingredients are furnished by sulphate and carbonate of lime). But this utility in heightened serous secretion must warn you against the employment of Pyrmont, whenever the slightest tendency exists to diminished alvine secretion, or to obstruction. It is perfectly clear that a very delicate stomach, prone to rebel against any obstruent agent, will not easily tolerate a beverage which contains such a large amount of the absorbent lime. The alimentary canal would be overstimulated, and either unhealthy diarrhœa or obstinate confinement of the bowels would result, with the natural congestive reaction to the brain. Pyrmont was formerly the most celebrated chalybeate of Europe. If it has lost something of its high repute, the cause must be sought in the great and preponderating importance now so justly attached to the chemical constituents of the mineral waters; and whereas in former times the fashionable Pyrmont was the chalybeate *κατ' εξοχὴν*, its utility in appropriate cases is still willingly admitted; but in diseases unadapted to the combined action of the lime salts, and iron, those spas are selected which promise a more favourable result from the absence of these occasionally objectionable ingredients. Though we must not take chemistry as the only guide, yet when we find a chalybeate indicated, it behoves us to choose one which promises by its secondary constituents to relieve the morbid complications accompanying the chief evil. That the diet ought to be an object of especial care must be sufficiently obvious, for the good effects of the Spa may be easily thwarted by a slight imprudence; and the lime, probably contributing its share towards the restoration of the required strength, if well tolerated and assimilated, must be expected to produce irritation if the digestion be wilfully weakened or overburdened. The chalybeate-mud baths, and gas-baths, with all other external appliances, are well contrived and frequently employed to assist the internal use of the water. The physicians of Pyrmont are Drs. Menke, Linker, Gieseken, &c.

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* Though he would generally not allow the use in this period, but he could safely recommend it here, from the absence of any tendency to miscarriage.

Driburg.—In travelling a short distance towards the south you perceive the town of *Driburg*, at an angle formed by the 'Teutoburger Wald,' pursuing an oblique north-westerly direction, and the Lippe-river, which moves straight from east to west to reach the Rhine near Wesel. It lies 300 feet above the surface of the Weser, in an agreeable valley, surrounded by hills of moderate height. The climate is rather bleak in winter. The peat-earth is particularly appropriate for mud-baths, and has the peculiarity of possessing no iron, but a great amount of sulphur. It has a fatty-saponaceous touch, is light and free from sand. It gives out a strong smell of sulphuretted hydrogen, and contains chiefly salts of lime, silica, alumina, sulphur, &c. The chalybeate of Driburg bears much analogy to Pyrmont, being distinguished however by a very firm adherence and a great amount of carbonic acid. It offers great inducements for those who prefer a more retired social life to the luxurious and fashionable tone prevailing in Pyrmont.

The *drinkquelle* contains 41½ cubic inches of carbonic acid, and 26¾ grains of solid ingredients in 16 ounces, viz. :—

8·42	sulphate of lime.
4·25	sulphate of magnesia.
3·88	sulphate of soda.
9·12	carbonate of lime.
0·51	carbonate of iron.
0·53	chloride of magnesium.

The *Hersterquelle* possesses thirty-two grains of solid constituents in similar proportions, with the exception of carbonate of iron (only 0·18 gr.), and more gypsum, (12 gr.)

The *Saatzer sulphur-spring* possesses 17 grains—no iron; but is in other respects analogous in its proportions to the Driburg water. The close union of carbonic acid causes even the greater amount of iron to be often more easily assimilated and better tolerated than that of Pyrmont. The paramount utility of Driburg (though less frequented) is exemplified by a few cases which occurred in the practice of Dr. Brück. A girl of twenty years of age being forced by her parents to give up an attachment to a dissipated individual, soon changed from a handsome blooming girl into a chlorotic sickly creature. Besides the ordinary symptoms, she was affected with such deep *coma* that she could only refrain from sleeping in the mornings and afternoons by the greatest exertion. The doctor ordered Driburg for drinking and bathing, with cold affusions over the head. After a course of four weeks, complete restoration to her former health had taken place. In a case of peritonitis, affecting a chlorotic girl of nineteen years of age, he was compelled by the urgency of the symptoms to extract blood. Though the peritonitis had disappeared, great prostration and *chlorosis* remained. Twenty-eight baths of Driburg water, with douche and internal employment of the Spa, produced recovery. An old Dutch gentleman, formerly robust, was now an emaciated and confirmed hypochondriac. Dyspepsia, languor, flatulence, obstruction, and a feeling of precordial oscillation constantly teased him. With difficulty he was persuaded to persevere for four weeks in the use of Driburg water, and when he departed he stated that he experienced no effect beyond a reddish appearance on the tip of his tongue. The assurance that this slight change promised greater improvement was ridiculed by the incredulous patient, who came however next year greatly altered to his advantage, and happy in reporting complete restoration, with the exception of a slight neuralgia of the plexus solaris, which still remained for a short time. Cases of sterility, sexual weakness, &c., were often cured. In fact the indications are very analogous to those of Pyrmont. Either the steel-spring is used internally and externally, or the Hersterquelle is taken internally (where less tonic and more solvent treatment is required), with chalybeate-baths; or steel-spring internally, with sulphur mud-baths. A case is mentioned of a corpulent plethoric lady of Ostfriesland, who employed the Driburg mud-baths with great advantage in *arthritic deposits of the hip-joint*, after having been obliged to discontinue the Nenndorf mud-baths in consequence of congestion to the head and metrorrhage, which appeared during their use. The Hersterquelle, with sulphur mud-baths, is recommended in lithiasis, vesical hæmorrhoids, and spasms of the bladder: the Hersterquelle contains about eleven grains of sulphate of soda and magnesia, twelve of sulphate of lime, nearly six carbonate of lime, and only 0·18 of iron. This combination quite justifies its reputation in urinary and vesical irritation.

The great abundance of highly important springs in a small compass in the west, might remind you of the Bohemian cauldron in the south-east. If you take the 'Teutoburger' forest as the western starting point, above 52° north latitude, and pursue the slanting south-eastern line of the Thüringer forest, Frankenwald, to the Fichtelgebirg, at 50° latitude, you have the numerous important spas within these two degrees of latitude between the Weser and Elbe rivers. But how different are their characters. Whilst in Bohemia you have thermæ denoting a great depth of origin, and amongst the constituents, salts of soda in preponderance, you perceive here no thermæ (except by boring: Oeynhausen), and salts of lime in predominance. A minor altitude, and the alluvial character of the soil, further indicate a less profound origin.

Schwalbach.—In order to examine a highly important Spa, in succession to the foregoing, I must request you to retrace your steps to the Taunus mountain, on the right shore of the Rhine, and permit me to accompany you from Biberich on the Rhine, where omnibuses are in attendance, through Schlangenbad to Schwalbach. The road passes through the celebrated 'Rheingau,' and is extremely picturesque and romantic. It takes about three hours to perform the journey, during which you are frequently compelled to ascend and descend steep hills. The approach to Schwalbach is marked by a rather steep declivity, requiring a steady hand to conduct the horses. The place is properly called *Langenschwalbach,* and lies four leagues distant from Wiesbaden, and six from Menz. The romantic valley of the Aar, with the castles of *Adolphseck* and *Hohenstein,* lies to the north-east. On the west an eminence slants downwards, dividing the valley into two smaller valleys. In the southern arises the *Weinbrunnen,* in the northern the *Stahlbrunnen.* Umbrageous walks of beech and lime-trees lead from one valley to the other.

The Weinbrunnen is the oldest spring, and was formerly employed exclusively. It was first brought into repute by the description of Theodor von Bergzabern (commonly called *Tabernæmontanus*), in 1581. Among other properties, he attributed to the spring the virtue of counteracting the effects of excessive indulgence in wine and other spirituous liquors; as headache, chilliness, &c. This circumstance is supposed to have given rise to its name. The bleakness of the climate has already been pointed out in comparison with the mildness of Wiesbaden—Schwalbach lying on the northern declivity of the Taunus mountain, whilst the same height serves as a powerful protection to Wiesbaden in the south. The proper season, therefore, does not commence before the middle of June.

Schwalbach lies 909 feet above the level of the sea. Its average temperature is 6° Fahrenheit lower than that of Wiesbaden (the altitude of which is 586 feet less). If, however, the mean temperature of summer be compared, Schwalbach has only four (Fahrenheit degrees) less of heat. West and south-west winds are most common.

Besides the two springs mentioned above, numerous other springs arise there, as the *Paulinen* and *Rosenbrunnen* (provided with a common enclosure), *Neubrunnen*, *Oberneubrunnen*, &c. The water is clear, sparkling, and has an agreeably acidulous, astringent taste. The temperature of the springs ranges between $7\frac{1}{3}$° to 8° Reaumur = 48° to 50° Fahrenheit. Less solid ingredients are contained in these springs than in the Westphalian chalybeates.

Contents of the Schwalbach Springs.

	Stahlbr.	Weinbr.	Paulinenbr.	Rosenbr.
Carbonate of lime	1·45 gr.	2·11	2·95	2·95
„ magnesia	0·88	3·12	2·75	0·98
„ soda	0·25	0·17	0·45	0·35
„ iron	0·75	0·83	0·65	0·91
Chloride of sodium	0·34	0·18	0·03	0·32
Sulphate of soda	0·21	0·16	0·02	
Carbonic acid	28 cub. in.	26	39½	26
Total of solid ingred.	3·83 gr.	6·59	6·86	5·51

The Rosenbrunnen is merely employed externally, and mixed, for bathing, with the Paulinenbrunnen; the others are both employed for drinking and bathing. The baths are heated by steam, which is introduced between the two bottoms of the baignoires (the upper constructed of metal and the lower of wood). Baths may also be obtained in some hotels, but as the water has to be carried there in casks, it would certainly be more advisable to use the bath-house in preference, where less separation of carbonic acid and deposition of iron take place, the water being conducted by iron-pipes into the bathing reservoirs.

It is a matter of great importance which spring is to be used. *Paulinenbrunnen*, the mildest of the three, acts as a solvent and tonic. Its great amount of carbonic acid causes it to be well elaborated. It has been found most strikingly effective in the instance of European invalids, who have been subjected for a long time to a tropical climate. The rigid torpidity of the liver, and the obstinate alvine obstruction, which refuse to yield to mercurials and aperients, give way here. This fact may appear strange, and is even wondered at by the very physicians who have observed it. Ought we not rather to expect the peristaltic intestinal motion to be diminished, because the chalybeates are so useful in profuse diarrhœa and laxity of the bowels? The results of Mr. Martin's experience and practice perfectly coincide with the effects of the mineral water. As I stated previously, *tenuity of the blood* was found by that distinguished gentleman to be the stubborn cause of the alvine inaction. The furred tongue, the dyspepsia, headache, languor, fretfulness, insomnia, &c., gradually diminished under the employment of pharmaceutic iron with solvents. The blood imbibes the needed element, flows with greater vigour through its ordinary channels, and is thus a more powerful provocator of central and peripheric nervous and muscular action. Next in frequency of employment is the *Weinbrunnen*, which contains most iron, among the drinking springs; but its carbonic acid is so firmly attached that it agrees better with erethic constitutions than the less substantial Stahlbrunnen, the most exciting of the three. The carbonic acid of the latter being somewhat more loosely adherent to the water, may be evolved in the intestinal canal before absorption, and thus the iron may become separated; hence a greater cerebral excitement may be expected in persons at all disposed to general or local plethora. The paucity of tempering ingredients is another reason why the characteristic stimulant and tonic effect of iron is more distinctly and purely displayed by this spring. With less iron than the Weinbrunnen, this element forms a greater proportion of the whole solid residue, ($\frac{3}{4}$ of a grain out of $3\frac{3}{4}$, the fifth part; in the Weinbrunnen, $\frac{4}{5}$ of a grain out of $6\frac{1}{2}$, about one-eighth of the whole.) In great general torpidity the Stahlbrunnen is therefore especially indicated.

Medicinalrath Dr. Müller, sen., found the Spa curative in forms of disease the most various, produced by anæmia, whether arising from serous or sanguineous profluvia or from debilitating lengthy diseases, or from exhausting mental labour. That chlorosis, tendency to miscarriage, sterility, catamenial irregularities, seek and find relief here, need not be mentioned, as the ordinary preparations of iron are such indispensable remedies in these disorders. But cases are recorded which seem to fall less under the category of diseases curable by steel, and which have been entirely removed by Schwalbach. An English lady is mentioned, who was cured of *paralysis* of the lower extremities by using Schwalbach during two seasons. Several painless tumours of the breast — of scrofulous origin — were cured by the baths of the Paulinenbrunnen. Paralysis of the upper extremities, after a violent attack of influenza, has also been cured there. In short, when the articular disability seems to result more from atony than from any arthritic or rheumatic cause, Schwalbach is often resorted to in preference to those Spas which professedly act against paralysis, as I detailed when treating of the akratopegæ. Persons whose abdominal organs have been weakened by excessive use of purgatives, and who are inclined to constipation, acidity, mucosity, or to diarrhœa, are cured here; for the abnormal function is based on organic over-stimulation on the one hand, which *must* end in debility and torpor, and in tenuity of the blood on the other (by the great loss of serum); both states are radically counteracted by the Spa; the right proportions once established, nature will do the rest, and restore the harmonious performance of the tasks allotted to each sphere. In hot weather the atmosphere somewhat inclines predisposed individuals to *diarrhœa.* Wherever this occurs, the course must be stopped, and appropriate remedial means employed. But proper precautions should be taken to prevent this ailment. Careful clothing, especially of the feet and abdomen, should not be neglected. The climatic peculiarity of the Spa admits of frequent changes of temperature. Hot days are sometimes followed by cool nights. How easily profuse cutaneous action may then be checked by carelessness, and a vicarious profluvium be brought about in the intestinal canal. Another important precaution should be given, viz., that the valetudinarian should beware of *drinking* cold water *intemperately* and indiscriminately between and immediately after the meals. Many persons think nothing can be more innocent than pure cold spring water. Indeed, nothing is more innocent; but inhaling the pure atmosphere of the fields cannot be a less simple and natural act, and still how injurious would it be in many over-excited conditions of the pulmonary organs.

During meals, both in consequence of the chemical and mechanical action going forward, the animal heat of the stomach must be increased to a more than ordinary standard. Cold water, poured in ad libitum, from its theoretical innocence, suddenly diminishes this necessary heat, and interferes therefore with the chemico-vital action. Besides, the strength of the gastric juice is impaired, its solvent acid becoming too diluted to perform its function properly. If water is introduced after fatty or oleaginous substances, these immiscible bodies may actually be separated by the water from the other digestible morsels, and thus be removed for some time from the peptic influence of the gastric juice during its continuous action. Though persons with strong digestive organs may do this and many other irregular acts with impunity, in certain atmospheric conditions favouring diarrhœa they ought to be warned of the inconvenience that might frustrate the course, or at least unnecessarily prolong the absence of valetudinarians from their cherished homes. To avoid drinking water after fruit is a popular rule too well known to require repetition. I wish I could persuade my continental friends to abstain from this prevailing habit of apparently innocent water drinking, in which case I feel convinced I should not meet in the records of the Spa so many instances of diarrhœa interrupting or annulling the course, nor would the advice be necessary to select an earlier period of the summer than the hot July and August, in order more securely to avoid this baneful complaint. I demur to this advice, and am emboldened still to advocate a more advanced part of the summer as the best period for this Spa, at least as regards persons disposed to catarrhal or rheumatic affections, and if your patients follow the simple warning with reference to clothing and drinking, I do not hesitate to state, that they will be secure against the dreaded diarrhœa. It is further useful to remind the English patient that, from his constitution and different manner of living at home, he ought as a general rule to be allowed a moderate quantity of wine with his meals, more particularly here.

Dr. Genth very judiciously recals to mind the observations of Liebig, concerning the part played by iron in the human or animal economy. That great chemist found iron in no other part than the hæmatine of the blood. The protoxide of iron having a strong tendency to absorb an additional atom of oxygen, gives up the carbonic acid with which it may be combined to gratify this propensity. On the other hand, peroxide of iron coming in contact with substances strongly attractive of oxygen, as carbon, hydrogen, &c., easily yields this additional atom, becoming reduced to protoxide, and then absorbs the carbonic acid, for the formation of which it has just furnished one constituent. This simple process forms then, according to Liebig, the whole basis of life. The red globules of arterial blood contain the highly oxidised iron, and are propelled rapidly through the larger vessels with little chemical change; but when the globules are detained by the minute peripheric tortuous capillaries, the organic parenchyma tends to combine with the plastic liquid, and the most exhausted particles allow their elements to be decomposed and to enter into chemical action with the newly-introduced warm and stimulating liquid. The carbon deprives the peroxide of iron of its less firmly attached portion of oxygen for the formation of carbonic acid, and then combines with the reduced protoxide, forming carbonate of iron; the hydrogen absorbs a portion of the oxygen for the formation of water. Not to speak of the other compounds formed, it suffices to bear in mind that a double purpose is served—combustion and generation of vital heat on the one hand; elimination of effete particles and reproduction of new ones on the other. The carbonate of protoxide of iron flowing in the venous blood, gives up its carbonic acid when acted upon by the atmospheric oxygen entering the lungs, and exchanges it for a greater amount of oxygen, so as to become arterialised, that is, peroxidised. The quantity of the oxygen of the blood depends therefore on the amount of iron present. If we introduce then more iron into the chyle and venous system, a greater quantity of oxygen will be attracted from the air, retained in the arterial course, and given up again in the capillary metamorphosis. The calorification must be more intense, and the elimination of effete particles more profuse. Hence a greater appetite during the employment of the chalybeate, because a more extensive waste takes place. Anæmic persons feel chilly, especially in the extremities; inanimate, and easily excited to increased cardiac action, because nature endeavours to correct the deficient sanguineous consistency by more numerous propulsions. Obstruction is another natural consequence of anæmia. The sparing amount of oxygen causes a less active chemical combination, and thus the ordinary emunctories are less often called upon to rid the body of effete substances. The skin feels clammy, flabby, and inelastic; the urine is pale, deficient in nitrogenous compounds; the alvine action rare. This state must continue as long as the sanguineous deficiency remains unrepaired; otherwise a hectic condition would necessarily ensue. Positive experiments serve as evidence of the increased red-blood globules of the blood through the employment of iron. In one case the quantity of red-blood globules amounted to 95·7 parts in 1000 after the exhibition of iron, whilst beforehand the proportion was only 46·6 parts. The quantity of water is considerably diminished, and that of cruor heightened under the use of iron. The diminution of the fibrine of the blood is accounted for by its adaptation to new organic productions in consequence of the more active combustion. Whenever the internal use of the water is not well borne the baths alone are used, and the specific effects of the absorbed ingredients are well marked. To prove the absorbing power of the epidermis, several experiments are adduced which clearly demonstrate this point. The hand immersed for a quarter of an hour in water of 112° F. had imbibed 98 grains. After a full bath of half an hour, of the temperature of 82° F., the weight of the body increased 570 grains; in a bath of 95° F., at several occasions, 552, 503 and 465 grains. Another experimenter found the weight of his body increased by 2550 grains in an hour, when the temperature was 79¾° F.; the increase was only 638 grains at a temperature of 90° F.; pulse and animal heat were unchanged. In a bath of 99½° F. there was neither increase nor diminution of weight, whilst the pulse became accelerated and the animal heat augmented. In another experiment at 98½° F., for half an hour, the perspiration broke out in torrents, the pulse was ninety-eight per minute, *and the loss of weight* 1159 grains.

The great importance of temperature is thus shown. As long as the secretive tendency of the skin is not called into violent requisition, not only absorption of water and its ingredients takes place, but the circulation is not accelerated. As soon as that limit is exceeded (which varies in different individuals) the heat causes a great turgidity of all the cutaneous sudatory glands, the retained animal heat receives an additional impulse, and the heart's action must naturally participate in the excited state of the organism. The more vigorous, plethoric, and inclined to congestion, patients are, the sooner will this limit appear, where excretion takes the place of absorption, and where the former sedative influence of the bath is exchanged for the dangerous orgasm alluded to. The more anæmic, weak, and exhausted persons are, the better will they bear a somewhat greater heat, for calefaction proceeds less energetically in their organism, and we may establish it as a rule, that imbibition will continue as long as the circulation remains undisturbed. This shows not only the importance of temperature as regards reaction, but it must convince you how the same remedy may vary in its effects, though employed in the same diseases.

Thus a person who takes a bath above the absorbing limit will wrongfully ascribe the result to the ingredients of the water, for whether beneficial or not, the protective reaction of the system has prevented the entrance of foreign bodies, and has even caused a greater elimination of effete substances. The heat of the blood may ordinarily be assumed as this limit. In general, at Schwalbach, the temperature of the baths is gradually lowered in proportion as the strength of the patient and the plasticity of the blood increase. The period of immersion is likewise regulated according to the susceptibility of the patient, and, as a rule, gradually prolonged. The great amount of carbonic acid gas in the water must never be lost sight of. However curative and useful its stimulating and reviving action, it naturally induces too great an irritation and subsequent relaxation of the nervous system, if its employment be carried to excess. The baths are justly recommended to be taken during calmness of the vascular and nervous system. The best period is about one or two hours after a light breakfast. Gentle exercise is usually taken afterwards, except with very weak individuals, to whom rest in bed is permitted for a short time. The symptoms of saturation are to be watched during the course, as an indication for its termination. They consist in languor, giddiness, headache, restlessness, bleeding from the nose, præcordial oppression, want of appetite, &c. To prevent a too early occurrence of this satiety, pauses are enjoined in the use of the baths (as an intermission every third or fourth day), and a careful regulation of the dose, so that the normal condition of the blood may be brought about gradually and imperceptibly. For it is apparent that the weaker and more attenuated our circulating fluid happens to be, the less it is able to elaborate and assimilate considerable proportions of stimulating liquids. Stormy inroad of foreign substances may sometimes produce striking sanative effects, but more often the well-intentioned friend will be repelled by the organism as an enemy, and mischief will ensue, if a too rapid amelioration is sought to be enforced. This happens daily in thousands of instances, and nowhere more caution is to be recommended than in the use of mineral waters.

This warning refers to all the Spas, and should not be omitted to be conveyed to your patients, who often attempt to make up for a shortened sojourn by excessive doses of the waters, with results easily imagined. They should be informed that the measure of health is not to be applied to the absolute abundance or deficiency of certain substances of the organism, but to *a well adjusted balance* between them. Maintain this balance, and you will preserve health; disturb it, and disease will ensue. As in the scales we shall not obtain an equilibrium by *throwing* substances on the deficient side, but by gradually adding the necessary weight, so is it in nature. When we see the various systems acting as safety valves for each other, and performing vicariously each other's functions, we cannot do better than follow the same track. In jaundice, for instance, we see the kidneys excrete biliary matter and carbonaceous substances. We find the excessive excretion of nitrogenous substances from the kidneys, leading to insoluble deposits, powerfully counteracted by vapour-baths, which increase the elimination of the same substances by the skin, &c. Many other illustrations might be adduced of this beautiful and wise provision of nature, but those mentioned suffice to show that you cannot induce violent action of one system without materially interfering with the functions of others which ought to remain unaltered.

Before concluding this lecture I should wish to bring to your notice a chalybeate which formerly enjoyed a very great reputation, and which is still frequently visited with great advantage in appropriate cases. I allude to *Spaa,* in Belgium, scarcely belonging to the German mineral waters, but still so near Aix-la-Chapelle, that it may well be included in our course. When you travel from Ostend towards Cologne you leave the railroad at Pepinster station, between Liége and Aix-la-Chapelle, and then proceed by an omnibus to the neighbouring *Spaa,* lat. 51°, east long. 6°. It is situated at an altitude of 1000 feet above the level of the sea, in a pleasant valley of the Ardennes. The chief spring, *Pouhon,* arises in the town, the others in the romantic environs. There are in all no less than sixteen springs. The Pouhon arises in the centre of the town out of ferruginous clay slate, and is frequently used for exportation. About a league to the south, in a somewhat more elevated position, in the midst of a wood and umbrageous walks, the *Geronstère* is situated. On the road to Malmedy rise the springs called *Sauvenière* and *Groesbeck,* half a league to the south-east of Spaa, and about three-quarters of a league from the Geronstère. The two *Tonnelets* lie half a league from the town, to the north-east of the Sauvenière. In a marshy meadow between the Tonnelets and Sauvenière the *Watroz,* and other springs, were formerly in use, but are now nearly abandoned. The temperature of the springs is 8° R. = 50° F.; their taste acidulous and rather piquant, with a marked ferruginous after-taste; their odour is somewhat peculiar, analogous to a hydrogen compound of iron. The *Pouhon* contains 3·37 grains of solid constituents, and eight cubic inches of carbonic acid gas, in sixteen ounces; amongst these four-fifths of a grain of iron; the others contain rather less iron and solid substances. Spaa agrees with some weak and irritable digestive organs which would not tolerate a more substantial chalybeate. The occasional sudden changes of temperature incidental to its geographical position must not be left out of consideration. On the other hand, the hilly walks in the immediate environs invite to pedestrian exercise, which must be considered as highly advantageous in such constitutions as are affected with sluggishness of the liver whilst their thoracic organs are healthy. The springs act as solvents and tonics. From the Geronstère some sulphuretted hydrogen is disengaged. The Sauvenière contains more steel than the Geronstère, and less than the Tonnelets. The air is very salubrious and bracing. The springs are particularly recommended in atony of the uropoietic organs, in acidity, dyspepsia, and tendency to gravel. In anæmic conditions generally they possess great efficacy, and deserve to be more employed than they are.

Contents of the chief Springs of Spaa.

	Pouhon.	Geronstère.	Sauvenière.	I. Tonnelet.	II. Tonnelet.	Groesbeck.
Carbonic acid	21 cu. in.	14	20	22	19·7	21
(According to Struve, 8.)						
Gaseous hydrogen compound of iron	—	0·04 c.in.	0·02	0·01	0·004	—
Total of solid ingred...	3·37 gr.	1·65	1·28	0·96	0·58	0·83
Sulphate of soda	—	0·04	0·07	0 02	—	0·02
Carbonate of soda	0·90	0·45	0·30	0·21	0·08	0·22
,, magnesia	0·31	0·16	0·10	0·08	0·06	0·08
,, lime	0·75	0·33	0·22	0·15	0·12	0·16
,, iron	0·87	0·45	0·43	0·39	0·25	0·24
(According to Struve,	0·37.)					
,, alumina	0·03	0·01	—	—	—	—
Chloride of sodium	0·20	0·09	0·06	0·04	0·01	0·04
Silica	0·28	0·10	0·07	0·04	0·02	0·04

Considering that nearly every severe and prolonged ailment produces a certain state of debility and anæmia, and thus leaves a greater susceptibility for the germination of morbific tendencies, it is obvious that chalybeates will very frequently be required, and that their adaptation to the respective individualities must be of the utmost importance. Though no blood may have been actually abstracted during an acute disease, an indirect loss of blood has taken place, the metamorphosis of vital structures into effete particles having proceeded as usual, whilst the required assimilation of ingested food for the reparation of the loss was impeded. Over-exertion of any organ or system, without derangement, is another source of weakness, for we may assume that a limit is placed to the action of each organic sphere, and that its capability is fixed as regards a certain number of movements. Thus, for instance, if the lungs have been dilated and contracted more often than usual for a certain period, their vitality must have been diminished in proportion, and we have a right to suppose that the same individual would have attained a higher age, ceteris paribus, without this increased action, though apparently *no trace* may be left of the previous illness. Without this supposition how could we conceive the same organ to be more susceptible to recurring disease than others which have remained intact, notwithstanding the unceasing change of structure, so that every particle of the formerly diseased organ may have been replaced?

The merely weakened circulating force, by depression of the nervous system, for instance, will ultimately result in the same injuries as if the quantity of blood were deficient. For unless propelled with a certain force it will afford a less powerful stimulus for reproduction and for generation of heat. This circumstance is probably the reason why we may give pharmaceutic preparations of iron for months to exsanguine and weakened nervous females without obtaining results so often observed by the use of chalybeate springs during three or four weeks. In the former instance we have rendered the sanguineous material more substantial and more capable of performing its functions. This is often sufficient; but you will find in your experience that a delicate female, after having been laid up for five or six weeks with severe enteritis, for instance, weakened only in a small degree by the necessary remedial measures, may sometimes take quinine and iron for a very long time before regaining her previous bodily and mental health, whilst a month's course of one of the above chalybeates, selected according to the previous history and constitution of the patient, will often have the effect of completely restoring the former strength. Though less iron was ingested in the latter instance, the remedy was accompanied by the highly stimulating carbonic acid, so that the moving force of the blood must have been augmented, and a greater power of provoking metamorphosis created; besides the addition of the required element. But the important question remains, what chalybeate shall we choose, if we find its tonic action indicated?

The analysis will serve as a guide in a great measure, but you must by no means wholly depend upon it. Thus in Spaa, the last chalybeate mentioned, without an explanatory difference being afforded by the chemical constituents, the Sauvenière is particularly renowned for cases of sterility, more than the Pouhon; whilst to the Groesbeck a very powerful diuretic action is ascribed, and its utility is extolled in gravel and lithiasis: the two latter are especially recommended in such cases of debility and anæmia as result from moist and damp habitations, from previous intermittent fever, and from scarlatina, especially in leuco-phlegmatic flabby individuals. The Pouhon is, on the contrary, recommended in obstructed portal circulation, in deficient bilification, in congested liver and spleen following intermittent fever; also in flatulence, digestive weakness, acidity, tendency to diarrhœa, passive hæmorrhage, &c. To prevent repetition, I will merely refer your attention to the remarks made on the special spas, which will readily point out the selection to be made amongst them. As regards the consequences of intermittent fever, you find Pyrmont, Schwalbach, and Spaa indicated, and it is therefore necessary to cast a moment's reflection on their origin. In tropical climates, where the function of the skin is excessively stimulated, and in low marshy regions, where the same function is inordinately impeded, the same morbid states often result, viz., intermittent fever and subsequent engorgement of liver and spleen. How is this? Probably because impaired sanguification is the consequence of both abnormal influences. In the tropical region the skin assumes as it were the work destined to other organs.

Without the due proportion of muscular exercise, circulation and vital combustion are promoted. This undue exaggeration of certain organic functions *must* ultimately produce great relaxation and atony of the over-worked organs. The serum of the blood being greatly diminished by the constant drain of perspiration, the blood can no more circulate with its wonted rapidity through its ordinary channels. Though the propelling force of the heart suffices to send it to the peripheric capillaries, its return through the portal vessel will be retarded, the more so as the liver has been likewise over-exerted and weakened, by partially performing the function of the lungs, rarity of the air permitting a minor entrance of oxygen for ordinary inspirations. An impaired chylification cannot but result. Thus a constant loss takes place on the one hand, without a sufficient reparatory sanguification on the other. Cachexia, passive congestion of liver and spleen, and tendency to intermittent and remittent fevers, is thus generated. The anæmic state of such invalids is better counteracted by chalybeates which powerfully promote the action of the liver, and remove the atony and susceptibility of the skin, as Franzensbrunn, Pyrmont, &c. The amount of carbonic acid, *inter alia,* must have a decisive weight in the choice. In *marshy and damp* places the ordinary function of the skin is somewhat checked by the watery exhalations of the circumambient atmosphere. The effete, nitrogenous, and carbonaceous principles repelled to the central organs, claim a greater amount of work from the abdominal viscera. The caloric generated in our organism is quickly abstracted by the surrounding atmosphere for the evaporation of the suspended watery particles. The powers of sanguification and calefaction must ultimately relax through over-exertion, and engorgement of the liver and spleen be superinduced, with a cachectic state, favourable to intermittent fever. Thus almost opposite causes may engender results apparently similar. In the latter instance, spas are especially recommended which counteract the debility and anæmia, without materially increasing the circulation of abdominal organs, as Spaa, in Belgium, where, more especially, the energy of the uropoiëtic and cutaneous systems is called into requisition, and where the bracing air of the Ardennes forest greatly contributes toward a successful result. The services of a very scientific English physician (Dr. Cutler) are available for English visitors at the latter place, besides several Belgian physicians of repute.

LECTURE XVII.

EMS.—SCHLANGENBAD.—BADEN-BADEN.

GENTLEMEN,—To-day I must request you to follow me again to Cologne, and accompany me in a Rhine steamer as far as Coblenz. You perceive the river Moselle entering the Rhine on its left shore. The river Lahn terminates its westerly course a short distance below, on the right.

Our present destination is a very celebrated Spa, situated on the right bank of the river Lahn, three leagues to the east of Coblenz, viz., *Ems*. It lies about eight leagues to the north of Schwalbach, and is enclosed in a narrow valley between high mountains, about a quarter of a league from the village of Ems. The opposite bank is considerably wider, and covered with gardens and meadows. The river, though large, flows so slowly, that scarcely any movement is perceptible in it. The surrounding mountains consist of clay-slate, interspersed with quartz. Greywacke and layers of shining coal are met with at greater depths. To the east of the Spa a curiously shaped group of rocks rises almost perpendicularly to a great height; to the west the *Bäderberg* is perceived, contrasting with the opposite mountain by being cultivated to the very summit. Vineyards and orchards clothe its slopes. On the other side of the river the mountain heights are intersected by valleys, and rise like colossal pyramids, covered with wood and verdure. The highest peaks are formed by the *Winterberg* and the *Molbuskopf*.

In contradistinction to the village, the Spa is called 'Bad Ems.' The houses destined for the reception of the valetudinarians are built along the river. The Curhaus is most conveniently arranged for residence and sanitary purposes, with water and douche-baths, &c. About half a league from the village of Ems, the so-called ‘ Silberhütte’ invites the attention of the visitors. On the opposite bank the mines of ‘ Lindenbach’ are perceived. About an hour’s walk along the dam of the Lahn, brings you to Nassau, with its antiquated castle. On the other side of the river a mountain rises, covered with trees and shrubs, and bearing the ruins of the old châteaux of Nassau and Stein.

Walks and roads are laid out to supply the invalid with means of exercise. Donkeys are generally used for ascending the distant hills and mountains. Though the valley offers many romantic spots and natural charms along the serpentine course of the Lahn, its confined position, the frequent blasts and winds, especially in the morning and evening, and the consequent vicissitudes of temperature, make it an undesirable locality for those who do not positively require the sanitary use of the waters. No temptations are offered to the pleasure-seeker for a prolonged sojourn.

The Bäderley is considered as the focus of the thermal springs which originate at its foot. The Spa is one of the oldest in Germany, and was known to the Romans, according to undoubted testimony. It belongs now to the domains of the Duke of Nassau. The various springs differ greatly in their temperature, the constituents being nearly the same in each. Though the number of visitors has considerably increased of late (to 4000 and upwards in one season), the former quiet tone is preserved, and no opportunity given for noisy amusements. This is chiefly due to the serious nature of the complaints of those seeking relief here, partly, also, to the peculiar local disposition. A covered colonnade now adjoins the Curhaus, for walking in unfavourable weather.

The ‘ Steinerne Haus’ and ‘ die vier Thürme’ are private property, but also serve for the accommodation of invalids. The former adjoins the Curhaus. In the ‘ Armenbad,’ indigent patients receive gratuitous accommodation. The water has a weak alkaline, saltish taste. Its colour is transparent. In the canals through which it flows, a reddish bath-stone is deposited, consisting of ferruginous lime-earth. Of the numerous springs, I will merely mention the principal ones.

I. The thermal springs of the Curhaus:—
The *Kesselbrunnen*, 38° R.=117½° F.
The *Kränchen*, 26⅓ R.=about 91° F.
The *Fürstenquelle*, 28° R.=95° F.

II. Springs of the Steinerne Haus:—
The *warm* one of 30° R.=100° F.
And *lukewarm* of 21° R.=77° F.

III. The thermal springs of the Armenbad have a temperature of 34° R.=116° F.

The highest temperature is possessed by those of the Pferdebad, viz. 45° R.=133¼° F.

Several warm springs originate in the bed of the river Lahn, near the Pferdebad, communicating to the water a heat of 32° R.=104° F., with a constant development of bubbles of carbonic acid and nitrogen gas; so that warm river baths might be constructed with great advantage to the patients.

The *Bubenquelle* (boys' spring) deserves also a special notice. It bubbles up a few steps from the chief spring, with a temperature of 38° R.=117½° F. This spring is merely used in cases of sterility; an ascending douche drives the water with some force into the vagina of barren women sitting over it. The great reputation of this Spa in cases of sterility must be accounted for partly by the stimulating mechanical agency, and partly by the alkaline effect of the water. The carbonic acid and nitrogen are present in an inverse proportion to the heat of the water.

The chief constituents are carbonate of soda and chloride of sodium.

According to Kastner, Kesselbrunnen contains thirty-one grains of solid ingredients in sixteen ounces, viz.:—

20·01	carbonate of soda.
1·97	,, lime.
1·19	,, magnesia.
0·03	,, iron.
7·02	chloride of sodium.
0·03	,, potassium.
0·54	sulphate of potash.
0·40	silica.
0·07	extractive substance.
13	cubic inches of carbonic acid and half a cubic inch of nitrogen.

The *Kränchen* contains twenty-nine grains of solid constituents, viz., seventeen of carbonate of soda, two of carbonate of lime, and $7\frac{3}{4}$ of chloride of sodium; in other respects analogous to the former; but it contains $18\frac{1}{2}$ cubic inches of carbonic acid, only two cubic inches of nitrogen. The altitude of Ems is 188 feet above the level of the sea. You are aware that Ems enjoys its greatest reputation for the cure of *laryngeal* and *pulmonary* diseases. Since the urgent recommendation of Hufeland, patients without number resort to the Spa, expecting confirmed tubercular consumption to be cured there. Many are certainly disappointed, especially if coming there after considerable progress has been made by the disease, the whole system largely participating in the pulmonary disorder by emaciation, nocturnal perspirations, hectic fever, &c. The waters are of course unable to change the morbid structure of the pulmonary tissue, or to arrest the destructive process rapidly going forward. Though, on the authority of Hufeland, no deterioration ensues by this Spa, still, when no rational judgment can promise relief, the exciting journey and the stimulating baths should not be advised in such advanced stages. It is however quite otherwise in the incipient stage of phthisis, or in mere diathesis, declared in persons of florid complexion and characteristic frame, greatly susceptible of pulmonary or tracheal catarrh, or hoarseness. If these phenomena appear as a reflex of abdominal mucosity, hepatic sluggishness, or tendency to acidity, lithiasis, irritative dyspepsia, &c., Ems offers itself as a unique and unrivalled remedy. Whilst the chloride of sodium tends to improve the digestive process, the chief ingredient, carbonate of soda, exerts its antacid and solvent power. Taken internally from the Kesselbrunnen and Kränchen, and absorbed through the epidermis by the baths of the other springs, it solves the tough viscid mucus of the intestinal and uropoietic passages, causing therein a more normal secretion and a less embarrassed capillary circulation. The congestion of the pulmonary vessels is thus diminished by an improved abdominal metamorphosis. The expectoration becomes looser, mucus more abundant, and approaching the normal condition. The confined state of the atmosphere might cause an inconvenient oppression, without the use of the waters, but during their therapeutic action the pulmonary weakness is not aggravated; on the contrary, the denser state of the air renders deep inspirations less necessary, consequently less exercise of the lungs is needed to obtain the required amount of oxygen. When the beneficial changes have been effected by the springs, then a more invigorating and bracing atmosphere is wanted. The above remarks are necessary to explain an apparent contradiction in a former lecture, concerning the great advantage of high positions in tubercular diathesis. The cure is there to be produced by the mechanical dilatation of the lungs, but here through the chemically alterative process instituted in another part of the system, when it is desirable that the secondarily affected lungs or trachea should remain as inactive as is compatible with health.

Less cutaneous irritation is produced by the Ems baths than by those of many other thermæ; indeed, an allaying sedative effect is produced on the nervous system, and an inclination to repose and sleepiness is frequently felt, but it must not be indulged on any account. Moving about, friction, or a moist cold cloth on the head, is frequently recommended to the bather. This shows how dangerous the baths are in any tendency to congestion, plethora, active hæmorrhage, &c. When the skin is less irritated through the small amount of culinary salt, a greater scope is left to the action of heat, and considerable caution is therefore demanded, especially in *warm* bathing, and *more particularly* by that class of patients usually resorting to Ems. The energetic flow of blood towards the circumference soon reacts, and returns with greater vivacity to the internal organs, especially to the lungs, heart, brain, or any other organ in a state of irritation or congestion. The Kesselbrunnen is most frequently drunk; the Kränchen, from the very scanty supply, is used less frequently. The Kesselbrunnen is preferred where a greater peripheric action is desired, or where abdominal congestions are to be removed. Vascular erethism is diminished, especially in the mucous membranes of the air-passages. Alvine action is, however, not promoted, but rather retarded.

The *Kränchen*, from its greater quantity of carbonic acid, has a more stimulating, solvent, and tonic power on the intestinal canal, energetically ameliorating the uterine and uropoietic functions. It is therefore more employed in abdominal sluggishness. The thermal springs of the Steinerne Haus are used as a transition between the two. The water is frequently employed with great advantage in the form of douche in neuralgic, rheumatic, and arthritic complaints; also as clysters and injections in hæmorrhoidal spasms, menstrual anomalies, fluor albus, &c. In cases of great pulmonary irritation the Kesselbrunnen is administered, with asses' or goats' milk. Persons subject to nervous erethism often find great benefit from undergoing a short course of eight or fifteen baths at Schlangenbad after having finished the cure at Ems. A few cases will best illustrate the diseased conditions in which relief or cure may be expected from Ems. Miss P., twenty-six years of age, of a slender and delicate build, had lost her mother, a brother, and one sister, by tubercular consumption. She was well, up to her twenty-first year. From that time the catamenial flux began to diminish in quantity, and to be accompanied by most violent abdominal spasms. These phenomena gradually deteriorated, so that she was ultimately confined to her bed during that epoch. Dyspnœa and pressure on the right side of the chest became now always associated with this period. These symptoms regularly reappeared every four weeks, till at last *pulmonary hæmorrhage* ensued each time, with violent spasms. Her bodily strength now began to decrease, respiration became less free, and cough with spitting of blood formed the climax at each monthly epoch. This state had lasted from the autumn of 1837 to the spring of 1838, when the patient was first seen by Dr. Franque. Physical examination exhibited weaker respiratory murmur at the upper part of the right lung. There was no dulness on percussion, no suspicious expectoration, nor nightly perspirations, during the intermission. The bowels were rather confined, though the appetite was unimpaired. The conclusion was arrived at, that no actual tuberculosis had developed itself, but that a merely congested state of the lungs existed, and would probably be developed to the fatal malady, unless checked in time. Ems was therefore advised. She arrived on the 6th of June, after having undergone one of the above-mentioned attacks. The Kesselbrunnen was ordered, with goats' milk, and lukewarm half-baths every other day. A few days before her expected menstruation, leeches were applied to the inner side of the upper thigh, and for the first time this dreaded epoch passed without spasms or spitting of blood. The course was continued for eight weeks, and the patient left without experiencing any more attacks up to January of the next year, the time when this report was communicated, being altogether greatly improved in health and spirits.

Mr. T., thirty-five years of age, showed a distinct phthisical disposition by his whole build, and also by the husky tone of voice, easily getting hoarse by any exertion. Two of his sisters had died from pulmonary consumption, as also his mother. Travelling and the use of saline baths had succeeded in strengthening his health in some degree, and enabling him to perform his professional duties with cheerfulness and energy; but pulmonary catarrhs appeared now and then, and became more and more frequent, alternating with toothache or other rheumatic affections. An issue and appropriate internal treatment alleviated these evils, but only for a short time, so that their return in winter and spring could always be anticipated with certainty. At last a violent catarrh was developed with a hollow cough, tickling and burning sensation in the larynx, hoarseness, restlessness, strong matinal perspirations, and great nervous excitability. The expectoration was mucous, liquid, free from blood, but sometimes containing small conglomerated greyish lumps. Appropriate treatment induced amelioration of the systems, but great exhaustion was left behind, with mental depression and tendency to profuse nocturnal perspirations. Traces of piles, which had showed themselves at the commencement of the next year, left no permanent effect on his state of health.

When he arrived in Ems, in the month of July, his pulse was of moderate frequency, his skin inclined to profuse perspiration, his voice husky; cough and expectoration inconsiderable; digestion normal. The Kesselbrunnen was commenced with precaution, and after some time baths were added, when no vascular erethism was apprehended from their use. Gentle douche to the neck was subsequently employed, as the morbid irritation seemed specially fixed in the larynx. The result was highly satisfactory, and when he left, he had merely to complain of a certain general languor, which frequently follows the prolonged use of Ems. The next autumn, winter, and spring passed with undisturbed health. He returned to Ems the following summer, to consolidate the former favourable result. In this he completely succeeded, though the course was interrupted for some time by intercurring diarrhœa, with inflammatory symptoms. From the numerous cases recorded, I purposely select those of minor severity, for in these, Ems may almost be considered as a specific, whilst in instances of more advanced pulmonary disease the chances of relief diminish. Though, as already mentioned, patients are sent thither from all parts of Europe, as a last resort, when the advancing destruction of the pulmonary parenchyma affords no reasonable hope of recovery, I would dissuade you again from following this example, unless peculiar individuality leads you to think that the *rational* action of the described alkaline and alterative remedy may produce such a general improvement as to stay the morbid condition of the lungs; otherwise, the very solvent power exercised on albuminous products by the water must hasten the morbid process, and consequently the fatal termination. Let all the mysterious attributes of these remedies be banished, and let no Spa be employed unless you can rationally explain to your satisfaction its relation to the morbid phenomena before you. Drs. von Franque, Vogler, von Ibell, Söst, &c. are amongst the most reputed physicians of the place.

I must request you now to accompany me to *Schlangenbad,* after having passed through Schwalbach, from which latter place it is only two leagues distant. Wiesbaden lies to the east, at a distance of three leagues; Mainz at four leagues to the south-east. If you take the curvature of the Rhine at Bingen as the corner, and cut off the portion of enclosed land by an oblique line passing from Coblenz to Bibrich, you have in this line, first Schlangenbad, then Schwalbach, and at last Ems. This will at once indicate to you the route to be taken when coming from London. If your destination be Ems, you disembark at the upper termination of the line, viz. Coblenz. If, however, you wish to visit Wiesbaden, Schlangenbad, and Schwalbach, it is more convenient to retain your places on the Rhine, till you have reached the inferior angle, viz. Biberich. From this spot the railroad takes you to Wiesbaden or Frankfort, whilst horse conveyances bring you through the pleasant Rheingau to Schlangenbad or Schwalbach. Those fond of picturesque scenery, and possessed of sufficient leisure, would certainly do well to travel by land from Coblenz through Ems to the southern spas of Nassau. Schlangenbad lies in a pleasant valley surrounded by woody hills, with many romantic spots. The neighbouring shores of the Rhine are frequently visited: the Niederwald, the height between Wiesbaden and Schwalbach, and other very picturesque mountains and vale-scenery invite the valetudinarian.

There are several springs of a temperature ranging between

21° and 25° Reaumur = 77° to 88° Fahrenheit. Their water is clear and perfectly tasteless. The chief use is external. The baths are very capacious and covered by 'Traas,' a substance bearing some resemblance to asphaltes. Heated water is let in to cover the bottom of the baths before the natural thermal water is introduced, because the cold bottom would otherwise reduce the heat too rapidly. The chief bath, however, is filled by the thermal water alone without admixture, the bottom being heated by steam. The *Schachtbrunnen* is the principal spring, having a temperature of 25° Reaumur = 88° Fahrenheit. The water sparkles little when drawn, but feels very soft, and is often exported as a cosmetic. According to the latest analysis, it contains $8\frac{2}{5}$ grains of solid constituents, viz. :—

3·36	grains	of carbonate of	soda.
1·70	,,	,,	lime.
1·19	,,	,,	magnesia.
2·15	,,	chloride of sodium.	

Only a few cubic inches of carbonic acid or other gaseous contents are present—viz., carbonic acid $1\frac{3}{4}$ cubic inches, and nitrogen $\frac{1}{5}$.

The baths have a peculiarly sedative influence on the nervous and vascular systems, and they are especially reputed for the beautifying power they exercise on the skin, to which they impart a satiny softness. In pure hysteric or hypochondriacal irritability, or spasmodic tendency without structural change, the Spa shows itself highly efficacious. Its cosmetic influence is to a great measure to be attributed to the combination of its carbonate of soda with the fatty cutaneous secretion, by which means a sort of very fine soap-water is generated, which rinses out the pores of the skin, whilst the lukewarm water enters the cutaneous absorbent vessels to dissolve and mobilise effete particles, and prepare them for elimination. The small amount of carbonic acid induces a very slight general stimulation, and may be the cause of the thermal ingredients chiefly confining their contact and efficacy to the skin and subcutaneous tissues, without penetrating to the central organs and provoking their reaction. Very irritable individuals have to begin with a somewhat higher temperature. For this purpose there are two taps attached to each bathing space, the one admitting the unheated and the other the heated thermal water, so as to communicate the required temperature to the whole. The position of the Spa is peculiarly favourable for giving tone to the weakened nervous system. Whilst its neighbour, Schwalbach, lies on the north-eastern declivity of the Taunus, Schlangenbad is situated on the south-western declivity (at an altitude of 897 feet), and protected by three considerable mountain groups from the blasts incidental to valleys. The mild atmosphere of the southern declivity is therefore partially enjoyed with the bracing mountain-air, and acts tonically and soothingly on the depressed or irritated nervous system. The soil is chiefly gravelly, abounding in quartz, and partially clayey, so that after rain showers the ground soon dries again and invites the invalid to wanderings in the charming environs and verdant fields and meadows. Dr. Bertrand, the present physician, found the Spa extremely beneficial in neuralgiæ of the skin and joints; for it both strengthens the functions and diminishes the morbid irritability of the affected organs. The female sex form the greatest number of patients. Its beneficial influence on the uterus and uterine nerves is especially remarked.

Hufeland says, that he knows of no Spa so adapted to retard or repress the articular stiffness and exsiccation incidental even to healthy old age, or prematurely induced by 'fast living.' 'I know by experience,' he continues, 'that a regular annual use of the Spa imparts to old age cheerfulness, agility of the joints, and prolonged strength. If we consider all its qualities, it is peculiarly fit for a lady's bath—for it beautifies the skin and renders it more juvenile and elastic, whilst it gives greater mobility to the limbs. Besides, the extremely romantic situation and the beautiful climate of those regions must be considered as auxiliaries.'

To illustrate the special indication of the Spa, I would beg leave to direct your attention to the following case mentioned by Dr. Reuter, of Eltville:—Mrs. S. v. B., thirty-seven years of age, married fifteen years, and mother of six children, had previously suffered with hysteria, at one time with profuse catamenia, subsequently with rheumatism, then with nervous headache, and when she arrived at the Spa, with *neuralgic pains in the loins.* She was greatly debilitated, especially in the lower extremities, convulsions of the abdominal muscles appeared, and inability of turning from side to side, besides great difficulty of sitting or of walking erect. The complexion was pale, the appetite and sleep diminished; occasionally chilliness seized her, with a creeping sensation of the skin, frequent desire of micturition, and a peculiar feeling of fulness and weight in her vesical region. Before her arrival she had been cupped near the sacrum, and rubbed with aromatico-balsamic liniments. At the Spa she took nothing else but thirty baths of 26° R.; an aromatic plaster was applied to the abdomen after each bath, to counteract the enteralgiæ, from which she suffered after the disappearance of the lumbar pains. She was discharged completely cured. The utility of Schlangenbad, after a course of Ems, will be the more obvious from the above remarks.

I have now to request your company to a Spa crowded by the greatest number of visitors, and well worthy of being considered as the world's exhibition of all the varieties of the human race. For scarcely a country of the old continent is there unrepresented, nor a language or dialect. The modern plilologist will sometimes be puzzled by the different sounds and words that strike his ear within a short walk. The name of the Spa is perhaps already guessed. We were led by the course to defer its consideration, notwithstanding the high estimation it must enjoy from the crowds that flock to its springs, and who have conferred on it the title of *Queen of the German Spas.*

You know therefore, Gentlemen, that I invite you to return to Frankfort, and to avail yourselves of the expeditious railroad to reach the beautiful and universally-admired Spa of

Baden-Baden. The particulars of the journey I have already described in the fourth lecture when treating of Wildbad, its easterly neighbour.

The town of *Baden* lies on the River Oos, in one of the most charming valleys of the Black Forest. To distinguish it from Spas of the same name it is designated abroad Baden-Baden. The Rhine is two leagues distant to the west, Karlsruhe eight leagues to the north, Strassburg twelve to the west. 'When coming from the village of Os, flourishing vineyards border the road to the left, and dark fir-trees, with mighty rocks, and the picturesque ruins of the old castle; to the right verdant fields and luxuriant meadows charm the eye, hills are covered with oak and beech trees, and alternate with private mansions, farms, and the tower of the Yberg. In the midst, Baden is perceived with its château and pinnacles; and in the back-ground the blue summits of the distant mountain-heights.' Part of the town is built at the foot of the hill; the other portion being situate on the hill itself, overlooked by the château at its summit. High mountains surround the town (the highest is the Mercuriusberg), and protect the charming valley against tempestuous winds. The distant prospects offered from the summit of the castle are really delightful. If the sky be serene, the eye may reach as far as the Vogesen mountains beyond the Rhine valley; to the south the high mountains may be seen which separate the dukedom of Baden from the kingdom of Würtemberg. ' In the environs the efforts of art rival the beauties of Nature. The walks and rides that may be undertaken by the valetudinarian for his amusement and recreation are varied and beautiful. With an altitude of 616 feet above the level of the sea, and the mountainous protection, the climate is equally favourable to an abundant vegetation and to the human inhabitant.

The air is pure and mild, and heightens the pleasure to be derived from the variegated and enchanting spots which are so profusely spread over Baden and its environs. It was known to the Romans under the name of 'civitas aquensis.' It is one of the most brilliant and fashionable spas, rivalling the celebrated Wiesbaden in elegance and luxury. Upwards of 20,000 visitors resort there during the season, that is to say, between the first of May and the first of October.

The springs are numerous, and supply a great abundance of thermal water.

The chief spring, *Ursprung,* possesses a temperature of 54° R. = 161° F., and issues from a rock consisting of hornstone and quartz. The *Brühbrunnen* lies a few paces off, near the two *Iudenquellen.* The *Höllenquelle* enjoys the highest position, and lies behind the Ursprung. The temperature ranges between 38° and 54° R. = 161° and 117½° F. The baths are chiefly supplied from the principal source, whence the water runs down into reservoirs. After being cooled, it is admitted by a tap into the baignoires, which receive from another reservoir uncooled thermal water, till the mixture reaches the appropriate temperature. The water is clear, transparent, of a somewhat saltish taste, inodorous, and little sparkling.

After some time a calcareous deposit, with some iron, becomes precipitated. A soft, unctuous, dark-greenish bath-mud is used for discutient applications. The vapour of the chief source is led into an adjoining building through a vapour-pipe and employed for natural vapour-baths.

The chemical constituents are nearly the same in the different springs. About 22⅓ gr. are contained in 16 ounces —viz.:

17½	grains of chloride of sodium.
1½	,, ,, potassium.
½	,, ,, magnesium.
2½	,, sulphate of lime.
⅒	,, carbonate of iron.
	and less than half a cubic inch of carbonic acid.

The Spa belongs thus to the halothermæ (warm saline springs), but analysis and experience class it amongst the weakest. The scantiness of chloride of sodium (nearly 30 grains less than Wiesbaden), and of carbonic acid (four cubic inches less), must prepare you to find it a considerably less efficacious remedy in cases of severe rheumatism or rheumatic paralysis, in which Wiesbaden affords such powerful assistance.

On the other hand, frequent instances will occur of slight rheumatic or arthritic affections, of chronic, torpid mucosity of the intestinal canal, general irritability and atony of the nervous system, morbid susceptibility of the vesical or urinary mucous membrane, &c., in which you might find the peculiar alterative, digestive, and solvent power of saline springs indicated, but without requiring the more intense action of the powerful Spas; in that case Baden will be very appropriately recommended. On account of the great advantages offered by the locality, its climate and environs are of high importance to those who are not seriously disabled. As Wetzler says, 'the air is so pure, the climate so mild, the landscape so rich in variegated beauties; high mountains with distant charming prospects here, smiling valleys there, ruins of antique châteaux, blooming villages, and luxuriant fields, alternating with superb vineyards, sunny plains and hills, and dark shady walks. The region is indeed paradisiacal, and blessed days may be passed here! Hastening away from confined chambers, resting from the troubles and toils of life, you may gather there renewed forces in the enjoyment of purer air and purer nature. Let him resort to Baden who has entered the retrogressive period of life; an annual sojourn of a few weeks in this terrestrial paradise may help to prolong his days. Let the citizens wander here who wish to enjoy the charms of rural life, and to contemplate nature in its finest attire. But let them participate in the pleasures of the luxurious table with moderation. They may also bathe with profit—for strengthening, refreshing, and purifying the skin. But whoever suffers from *very serious* ailment, and expects to be chiefly cured by the agency of the mineral water, must not be sent to Baden.' To sum up, if the patient is too unwell to profit by the numerous resources of climate and locality, his case is not adapted to Baden. There are now very well contrived *Russian vapour-baths* at the Goldene Hirsch, which assist materially in the cure of rheumatic diseases, for which

Baden is resorted to, but of course the relief has then to be effected *in* but not *by* the Spa. Hofrath Dr. Gugert records an instance of scrofulous ulcers of the ankle occurring in a child of five years of age, which were cured by the thermal vapours of the chief spring, after the ineffectual employment of anti-scrofulous remedies and spas. He enumerates some other cases of scrofulous eruptions, of gout, and of pulmonary and laryngeal catarrhal irritation, as cured or relieved by the thermal vapours. In and near the town (Lichtenthal) chalybeate springs originate, and are effectually employed after a course of Baden. They contain 2 grains of solid ingredients in 16 ounces—viz.: $1\frac{1}{2}$ of carbonate of iron, $\frac{1}{10}$th of carbonate of soda, $\frac{1}{10}$th of carbonate of lime, $\frac{1}{4}$ of chloride of magnesium, but *no carbonic acid;* hence you may beware of confounding them with chalybeates containing less iron, but accompanied by the indispensable volatile gas. Though the chief employment of Baden be external, the water is also frequently ordered internally—pure or with whey. To render it more efficacious in torpid venous obstruction of the abdominal vessels, an imitation of Karlsbad water is artificially prepared, by adding, according to *Kölreuter's* prescription, sulphate and carbonate of soda, so that about 50 grains of solid constituents impregnate a pint of the water. The physicians seem all greatly occupied during the season, (Hofräthe, Pitschaft, and Guggert, medicinalrath Dr. Kramer, Drs. Ruff, Müller, Gaus, Federer, Maier, &c.) though a very numerous portion of the visitors seek only recreation amid the charms of the surrounding scenery. The artificial aid just alluded to, leads me to direct your attention to several attempts made at various periods to watch the operations of nature in her secret laboratory, and endeavour to compensate for her deficiency by artificial means.

If baths of *carbonic acid* are required, they may be prepared chemically by mixing soft limestone and sulphuric acid (diluted with about fifteen parts of water) at the bottom of a tub; causing the patient to rest within for the destined time, with his head reaching out of the space. Four and a half ounces of carbonate of lime would be required for each cubic inch of carbonic acid. But instead of this costly process, Dr. Döbereiner proposes the formation of carbonic acid by the process of *fermentation*, in the following manner :—Mix four or six pounds of well bruised barley or oat malt with an equal quantity of lukewarm water, into a dough. After half an hour pour twenty-four or thirty pounds of boiling water over the mass, whilst being constantly stirred. Leave the whole till its temperature has sunk to 20° or 25° R. = 77° or 88° F.; then mix it with a pound or a pound and a half of good beer yeast (lees), and pour the whole into a tub, about five feet high, and two and a half feet wide. This is covered, and left standing for a few hours, when fermentation will commence, and carbonic acid be generated in abundance, displacing the atmospheric air previously present in the vessel, carbonic acid being so much heavier than common air, that 100 cubic inches of the acid weigh upwards of 47 grains, whilst the same volume of air only weighs 34½ grains. As soon as this process has taken place, which can be ascertained by the extinction of a lighted candle placed in it, the bather enters the bath, with his head reaching out of the tub, and steps on a tripod placed over the fermenting mass. A piece of board ought to cover the tub, with space cut out for the protection of the protruding head. If you recal to mind the numerous instances mentioned of the great utility to be derived from the external application of carbonic acid, you will not fail to recommend the above contrivance where carbonic acid gas baths are indicated; the more so, as undressing is unnecessary, for the gas easily penetrates the pervious clothes, and exerts its beneficial influence on the peripheric nervous system.

As there are a great many families and private establishments brewing their own beer, the carbonic acid may be collected more easily still. For whilst fermentation is going forward, the vat has merely to be covered, and an opening to be made in the side, a few inches below the superior border of the gas. By merely introducing a pipe which communicates with an empty barrel, placed in a lower position, the carbonic acid will readily flow into the latter, which has then to be closed, and carried without shaking to the place where it is required for use.

Baths of sulphuretted hydrogen.—Hydrothionic acid (as the gas is also called) is lighter than carbonic acid, but somewhat denser than air, 100 cubic inches weighing upwards of 36 grs., or one cubic inch nearly two-fifths of a grain. It is likewise irrespirable; but mixed with air it proves highly advantageous, as I have shown to you when speaking of the sulphurous Spas. Its deoxidising property renders it highly valuable in diseases produced by metallic oxides, or kept up by a too rapid oxygenation. Professor Döbereiner states that often when he was exposed to the inhalation of chlorine gas or nitrous acid, during his chemical operations, he obviated the injury that might have resulted to his lungs from these noxious vapours, by subsequently inhaling air mixed with sulphuretted hydrogen. In pulmonary irritation, which would be aggravated by acids, or too energetic oxidation, inhalation of air impregnated by sulphuretted hydrogen is supposed to be highly useful. It is prepared by mixing sulphuret of iron, or of calcium, with muriatic or diluted sulphuric acid. I would not advise its artificial inhalation, from the extremely poisonous character of the gas, if the proper limit be overstepped, and from the smaller amount of protection afforded to the lungs by its minor density (compared with carbonic acid), but I cannot see why artificial sulphur baths should not be more frequently prepared, and water made to absorb sulpuretted hydrogen, by introducing into the bath first the sulphuret, and then the acid. As soon as gas bubbles rise to the surface, the bather should be allowed to enter and derive the benefit which he is precluded from obtaining at the natural sulphur baths.

Baths of ammonia gas.—From the advantageous sojourn of consumptive patients within horses' stables (in which ammonia and carbonic acid are chiefly generated by the putrefaction of the excrements), Dr. Döbereiner recommends the trial of artificial gas baths of ammonia. These might be prepared by strewing two ounces of *muriate of ammonia* with an equal quantity of *slaked lime* on a heated brick. The lime will soon expel the ammonia, by taking its place, and the air of an ordinary chamber will be sufficiently impregnated with ammonia gas. The process of rapid oxidation going forward in the lungs of such invalids may possibly be checked, and the caustic action of the entering oxygen blunted to a certain extent, whilst at the same time the tone of the pulmonary nerves may be gently raised, but not excited, through the dynamical influence of the volatile alkali. Ammonia is specifically lighter than common air (0·589), 100 cubic inches weighing only 18¼ grains.

Baths of chlorine and hydrochloric acid gas.—The great utility of saline exhalations in certain cutaneous diseases and in phthisical tendency, is amply illustrated by the benefits derived from the atmosphere of the graduation works at the various saline Spas, and on sea-shores. When treating of the respective localities, I expatiated on the greater ease with which the function of respiration is invariably performed. There exists an instinctive desire of profounder inhalations, analogous to that experienced at greater altitudes. This may be partially explained by the great tendency of chlorine to combine with hydrogen, and of hydrochloric acid to attract ammonia. The air is thus divested, in a great measure, of the admixed animal exhalations, and offered to the lungs in a purer condition for respiration, analogous to the atmosphere of higher localities. Hence respiration is performed with a greater sensation of ease, and with more intensity. This extension of the pulmonary cells prevents the deposition of tubercular matters in the interstitial pulmonary tissue. Hence the greater advantage of these exhalations in phthisical tendency; whilst in fully developed tubercular consumption the process of liquefaction and destruction is hastened for the same reason. Thus it is perfectly rational to find patients in an advanced state of consumption benefited by the ammoniacal exhalations of stables, where minor dilatation of the lungs is required; whilst persons affected with phthisical tendency, or incipient tuberculosis, obtain relief from saline exhalations and high localities, where the lungs are dilated to a greater degree.

It may thus be occasionally required to generate chlorine and hydrochloric acid gas, for artificial vapour-baths. By mixing three parts of sea salt with one of peroxide of manganese, and adding two parts of sulphuric acid (diluted with an equal quantity of water), the evolution of the gases will take place, but the process will go on more rapidly by applying gentle heat. The sulphuric acid combines with soda, causing the muriatic acid to be driven out from its combination. The great tendency of the peroxide of manganese to abstract one atom of hydrogen for its less adherent atom of oxygen, causes the hydrochloric acid to give up its hydrogen, so that pure chlorine gas escapes, with some muriatic acid. Some protection is afforded against the injurious influence of the chlorine by its greater density, which, however, does not prevent its ultimately mixing with the higher strata of the air. Caution is therefore required, and a few ounces of the above mixture ought only to be employed for ordinary purposes. Excess would be as dangerous as the proper quantity might show itself beneficial.

Vapour-baths.—The vapour penetrates more easily into porous bodies than the liquid, on account of the inherent warmth, which keeps it in a gaseous state, and at the same time distends the pores and prepares them for the entrance of the vapour. To prepare a simple vapour-bath nothing is required but to place a heated brick on the bottom of an open tub, and to cover it with a piece of wood for the legs of the individual who is to use it: some water poured on the brick, becomes directly transformed into vapour. You cover the tub with a dry cloth, leaving an opening for the head of the bather, and your simple vapour-bath is ready for use. To prepare a *medicated* vapour-bath, you have merely to add substances by which carbonic acid, ammonia, sulphuretted hydrogen, &c. are generated.

As regards *river-baths*, those ought to be preferred which have a sandy bed, so that their water is pure and soft. Spring water is less appropriate for bathing, on account of the sulphate and carbonate of lime it contains, which render it too hard.

To procure advantages approaching those derived from the natural mineral waters, it will be advisable to impregnate water with carbonic acid for internal or external use. Not only the acidulous water itself will be highly useful in many complaints, but you will be able to dissolve many substances in it, which are otherwise insoluble in common water, and thus you may imitate several mineral waters for the use of your patients with great advantage. The carbonic acid has merely to be evolved in the manner above described, and brought in contact with the water. You raise the temperature of the water for bathing by adding hot water, after having previously dissolved in the water any salts which it may be advisable to add, as chloride of sodium, carbonate of soda, &c.

To produce carbonic acid and various salts of soda, for instance, at the same time, mix about three cubic feet of water with 5½ ounces of deliquescent carbonate of soda. If you desire sulphate of soda, add, gradually, 4½ ounces of sulphuric acid. If chloride of sodium be needed, substitute muriatic acid. At all events, the stronger acid will combine with the base and drive a cubic foot of carbonic acid into the superjacent water. In any brewery or distillery they might cause the carbonic acid resulting from fermentation to flow into bottles placed on a pneumatic trough; these might then be lightly corked and left inverted in vessels filled with the necessary solutions. Gradually the liquid enters the bottles and absorbs the carbonic acid. As soon as you have this desideratum, you may readily imitate any required mineral water. Suppose, for instance, you wish to prepare *artificial Selters-water:* you have to dissolve sixty grains of deliquescent and anhydrous carbonate of soda in an ounce of water; then you mix it with forty-six ounces of carbonic acid water, which I will designate *acidulous* water. You adapt a cork to the bottle, and then add a sufficient amount of pure inodorous muriatic acid for the saturation of fifty grains of carbonate of soda. The cork is then quickly fixed, forty cubic inches of carbonic acid are generated, and mixed with the water. A small quantity of lime and magnesia is omitted. If you have no ‘acidulous’ water at hand, you may prepare a sufficiently close imitation by first putting the required amount of muriatic acid (403 grs.) into 1000 cubic inches of water, then adding forty grains of carbonate of magnesia and ninety-five grains of carbonate of lime. When these are dissolved, add three ounces of carbonate of soda, and then close air-tight.

To prepare *chalybeate waters* for drinking or bathing, dissolve two drachms of sulphate of iron in two ounces of water, and add three drachms of bicarbonate of potash previously dissolved in two ounces of water; some carbonic acid is evolved, and carbonate of iron partially precipitated and partially held in solution by the disengaged carbonic acid; four grains of carbonate of iron remain dissolved in an ounce of water. The precipitation of iron may be prevented altogether by dissolving it in nine ounces of water to which ten grains of concentrated sulphuric acid have been previously added. By introducing then the solution of the carbonate of potash, such an additional quantity of carbonic acid is evolved as to suffice for the complete solution of the new product—carbonate of iron.

To prepare an efficient and powerful *chalybeate-bath*, take 516 grains (about an ounce) of freshly crystallized sulphate of iron, dissolve it in hot water, and then put it into a solution of 380 grains (about six drachms) of concentrated sulphuric acid. Pour the whole into the bath and stir: then dissolve fourteen drachms (840 grains) of carbonate of potash in hot water, and add it gradually to the bath, which is constantly stirred. Carbonate of iron, carbonic acid, and sulphate of potash are produced, and remain dissolved in the water. These ingredients may of course be modified to suit different complaints or constitutions.

To obtain a strong *sulphur-bath,* put about two ounces of powdered chalk and the same quantity of sulphuret of lime into the bath: then add, gradually, three ounces of concentrated sulphuric acid. The former two substances will become decomposed into sulphate of lime, carbonic acid, and sulphuretted hydrogen, with which the water will become impregnated. I need not explain, that the sulphur previously combined with the lime separates from this base and combines with hydrogen to form sulphuretted hydrogen. The electro-chemical relation between the two generated gases is called into play by the moving human body, and hence their dynamical effects will be increased by the movements of the bather and the varying points of contact between the water and the surrounding air. In natural acidulous waters, the body causes the carbonic acid to be disengaged by the contact with the water, and hence the effect must be more powerful than if immersion in water with disengaged carbonic acid took place. This is demonstrated, for instance, by the power of hydrogen to combine with the metals, merely in its nascent state, whilst free hydrogen could not be made to combine with the metals.

For drinking, artificial Selters-water may be merely mixed with a few grains of sulphuret of lime* (about five grains to a pound). The free carbonic acid will gradually decompose the added salt into carbonate of lime and hydrothionic acid.

Baths containing *culinary salt,* or *carbonate of soda,* need not be further described, as from the solubility of these salts any other process beyond dissolving them in the bath becomes unnecessary.

A bath containing *carbonate of soda* acts like a kind of soap-water, the alkali forming a saponaceous substance with the oily and fatty exudations of the skin; the pores become therefore rinsed, and the exhalation of effete substances is equally promoted with the imbibition of healing agents that may be dissolved in the liquid.

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* Prepared by heating equal parts of sulphur and powdered oyster shells.

Acid-baths are found great adjuvants in derangements of the liver, and in phosphatic diathesis of the urinary deposits. Three ounces of muriatic acid and two of nitric are used for a bath, which is to be taken in a wooden vessel.

For *alkaline-baths* about two pounds of carbonate of potash are taken.

Artificial *sea-baths* may be prepared by adding ten pounds of common salt, and six ounces of sulphate of magnesia. For persons of an irritable skin, two pounds of *Flanders glue* dissolved in boiling water may be added.

To prepare *isolated baths,* two drachms of iodine and four drachms of iodide of potassium may be dissolved in distilled water, and put into the bath. The following imitation of *Barége baths* is frequently employed in France:—Crystallized *sulphuret of sodium,* carbonate of soda, and chloride of sodium, two ounces of each, dissolved in ten ounces of water, and enclosed in a bottle till required for the bath, into which the mixture is put when the patient enters. Four ounces of *sulphuret of potassium,* and two pounds of Flanders glue, form also an efficient mixture in cutaneous impurities.

Till now, Gentlemen, the skin has merely so far entered into therapeutic treatment, as to assist in antiphlogistic measures, to receive applications of counter-irritants, or at the most for the promotion of violent exhalation. But as the inflammatory tendency of diseases seems gradually to diminish by the refined and civilized modes of living, so that depletory measures are much less frequently demanded than alteratives and tonics, is it not reasonable to urge that this most important organ, the skin, should be more generally called into requisition for the cure of diseases? It performs not only an indispensable absorbent and exhaling function, but it constitutes the vicariating and regulating assistant as it were of so many internal organs. If the circulation be increased to any extent, forthwith the skin compensates for the more rapid metamorphosis by eliminating more nitrogenous particles. If the skin be slightly contracted by external cold, we find the mucous membrane of the nose immediately secreting more mucus than usual, and the renal emunctories called into greater activity. Any disproportion between ingested and assimilated substances, any dyskrasia generated in the blood, is immediately reflected on the epidermis, either by mere change of colour or by actual deposits. I may here remark that it is at first sight wonderful, of *how little* use baths and all external contrivances are in the treatment of obstinate cutaneous diseases, notwithstanding all the theoretic curative powers. How is this? Simply because cutaneous diseases are wrongly considered by many persons as external complaints. Their causes lie hidden in the processes of the internal organs, and often these diseases may merely result from the efforts of nature to expel noxious elements by the skin. This truth will be admitted by those who have the greatest experience in the treatment of cutaneous diseases. To convince yourselves of this fact you have only to read any of the standard works on this branch of physic, and you will be struck by the great number of remedies recommended for each of these ailments, evidently showing the frequent failure of each. For you will never meet with such a great variety of remedies in the treatment of internal diseases, with the exception of those that are considered as incurable. I allude to this, not by way of censure, but as pointing out a sad truth; and I would further state that if the skin were considered with the same care before any eruptive change has taken place, as afterwards, probably many cutaneous diseases would entirely vanish from the category of disorders. Assuming that no person would be affected with an eruption, if his internal organs would act in perfect regularity, ought we not to direct our chief attention to internal treatment in incipient cutaneous disorders? and might we not on the contrary, in internal systemic derangements seek to restore the disturbed harmony by making use of the compensating and regulating power of the epidermis? Of course I do not speak of the eruptive fevers or of the infectious itch; these are subject to other laws. But I maintain the necessity of more frequently following the path of nature, and availing ourselves of the vicariating property of the skin; and thus the artificial baths above recommended should be employed in many instances, in which at present all remedial agents are introduced by the intestinal tube.

LECTURE XVIII.

OEYNHAUSEN.—NAUHEIM.

GENTLEMEN,—In to-day's lecture I shall bring to your notice the two most recently discovered German Spas, viz. *Oeynhausen* and *Nauheim.*

Oeyhausen, (long. east 9°, lat. 52°), the youngest member of the family of spas, may be reached from Cologne in eight, and from London in about thirty-four hours. It is within sight of the Rehme Station,* near the junction of the Werre and the Weser. It owes its origin to the salt-works, to which it is contiguous (*Neusalzwerk*), and though the last discovered (since 1845), it already enjoys a high reputation in the cure of diseases in which the saline springs (halopegæ) are indicated.

It is situated between Minden to the north, and Herford to the south, at an equal distance of ten miles, Vlotho lying five miles distant in an easterly direction. To obtain a fresh supply of salt, a hole was bored (now 2,220 feet deep), when, unexpectedly, a warm salt-spring flowed out in great abundance, giving rise to the spa under consideration.

The bore-hole and its adjoining baths are situated to the south-west of the salt-works, in a fertile valley, extending beyond the Werre and joining the valley of the Weser. It is bounded on the north by the Weser mountains (900 feet high), which can be seen for several miles, and which the River Weser intersects in the *Porta Westphalica,* near Hausberge (five miles from Neusalzwerk).

The steep Margaret and Jacob mountains (constituting the Porta Westphalica) are invested with a pleasant appearance by groves of beech, and the tower built upon the former mountain affords a charming panorama of the environs. The Demberg and Kappenberg form, respectively, the southern and eastern frontiers. Behind these rise the Steinegge, Ebenöde, &c., enclosing Vlotho in a deep valley. From the highest point (the Bonstapel), the town of Minden can be discerned in a due northern direction through the Porta Westphalica. The spa is thus protected by the surrounding mountains from violent extremes of temperature, without being exposed to the foggy exhalations of the Werre and Weser, these rivers lying below its level. A mild and healthy climate prevails, though sometimes subject to sudden changes. The mean temperature of the soil is $7\frac{3}{4}$ to 8° Reaumur = 50° Fahrenheit. The mountain masses of the environs belong to that class formed of horizontal layers. The lowest stratum is composed of shell-lime. Above this appear the white and red sandstones, then variegated layers of marl (mostly red); a peculiar layer of white calcareous marl then follows, frequently employed for manuring the fields, and containing numerous crystals of sulphur-pyrites. Towards Neusalzwerk it is covered by black slate and pebble-stones, which former may be considered as the transition into the lyas formation that occupies the south. We moreover find tertiary marl in the Deberg, with remains of testaceous animals, and a considerable stratum of tufaceous lime between Valdorf and Vlotho. The bore-hole lies 217 feet higher than Amsterdam, and thus extends to 1994 feet below the level of the sea, probably the greatest depth ever reached. The salt water was first perceived at a depth of 574 feet, containing $1\frac{5}{8}$ per cent. of salt, and supplying $\frac{2}{3}$ cubic foot of water per minute; thence, the quantity of water, the temperature, (about one degree Reaumur for 120 feet of depth), and proportion of salt, gradually increased. At 600 feet the temperature was $12\frac{1}{2}$° R.; at 1004 feet, 15° R.; at 1100 feet, 18° R.; at 1586 feet, $19\frac{1}{2}$° R.; at 1595 feet, 20° R.; at 1951 feet, 25° R.; and at 2219 feet, $26\frac{1}{2}$° R. = 92 Fahrenheit. From $1\frac{5}{8}$ per cent. the proportion of salt increased to $4\frac{1}{2}$, and the flow of water from two-thirds of a cubic foot gradually augmented to fifty-four cubic feet per minute.

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* The last station before Minden.

The upper part of the hole is now enlarged to a width of nine inches (as far as 1,600 feet), and the widening operations are still continued. Analysis of the water compared with that of the Mediterranean (by Professor Bischoff of Bonn), shows in 10,000 parts :—

	Oeynhausen salt-water.	Water of Mediterranean.
Chloride of sodium	333·850	251
„ magnesium	10·783	52·5
Sulphate of potash	0·47	—
„ lime	29·947	1·5
„ magnesia ..	26·038	62·5
Carbonate of lime......	8·686	1·5
„ magnesia	5·021	
„ iron......	0·668	—
„ manganese	0·014	—
Silicic acid	0·466	—
Bromine	quantity undetermined	
	415·944	369

In 16 ounces, the thermal brine of Oeynhausen contains 319 grains of solid ingredients —viz.

256⅓ gr. chloride of sodium
8¼ „ magnesium
⅓ sulphate of potash
22 9-10ths „ lime
19 9-10ths „ magnesia
6½ carbonate of lime
3¾ „ magnesia
⅛ „ iron
1-100 „ magnesia
⅓ Silicic acid
Specific gravity 1017

No trace of iodine has been found, but a considerable amount of bromine, though its precise quantity has not yet been determined. In the chemical manufactory near Neusalzwerk, the bromine is procured from the mother-lye of the salt-water. According to the above analysis the 'Soole' (salt-spring) may be considered as sea-water modified by the addition of bicarbonates and carbonic acid, besides a higher natural temperature. The water remains clear and transparent, as long as it is conducted in pipes; but exposed for some time to the atmosphere, it gradually loses its carbonic acid and becomes turbid, depositing oxide of iron and carbonate of lime. Three cubic feet of free carbonic acid and other gases (the latter at the rate of six per cent.) escape per minute from the bore-hole. The absorbed carbonic acid amounts to $\frac{7}{10}$ of the volume of brine, so that forty-three cubic feet of the acid are obtained per minute with the water. Only at the depth of two feet the carbonic acid begins to be evolved, at a greater depth it is completely absorbed. The proportion of the free to the combined acid is as one to fifteen. A weak bitter spring near the 'Soole' is frequently used for drinking. It contains in 1000 parts $19\frac{1}{2}$ of solid ingredients—($7\frac{1}{2}$ sulphate of soda, $2\frac{1}{2}$ sulphate of magnesia, $3\frac{1}{2}$ chloride of sodium, 2 chloride of magnesium, $\frac{1}{4}$ chloride of calcium, 3 bicarbonate of lime, $\frac{1}{2}$ bicarbonate of magnesia.)

At present there are sixty-seven baths of different classes, the baignoires of which are fifteen feet below the level of the bore-hole. The water rises in the bathing-house in a perpendicular shaft to the height of twelve feet, and fills the basins under the pressure of its column from below. At the sides of the baignoires the filling pipes are so contrived that a wave-like motion can be communicated to the bath, and that the stream can be made to enter in one spout, or in numerous fascicular spouts. The carbonic acid can be evolved near the bottom or at the surface of the bath, with quite a different effect on the bather. The mouth-piece of the filling tap is provided with screw-windings, to which a copper tube may be attached, reaching nearly to the bottom of the basin, or a bent tube with a leather pipe, or a sieve-like head-piece, according to the intended use. A great importance is attached by the physicians to the kind of bath employed, for one baignoire may exhibit four or five baths of perfectly different physical effects, and these modifications are made use of in the treatment of the respective diseases. For a *quiet bath,* the side-tap must be closed; the water flows in imperceptibly from the bottom, with a comparatively diminished evolution of carbonic acid gas, and flows out again as soon as it reaches a certain height, at the other end of the bath. The effect is again different, if the filling tube be merely held and not screwed to the tap. Atmospheric air entering the water with carbonic acid, the latter rises, continually hissing and foaming; by an ascending tube, wave-like motions are formed on the surface. If the leather pipe or short bent tube be fixed to the side-tap, the stream and evolution of carbonic acid can be directed to any layer of the water or to any part of the body (as douche). If the water is allowed to fall from the tap into the basin, a lively wave-like motion is communicated to the whole mass, with constant development of foam and hissing, and the most complete disengagement of carbonic acid.

Though the energy of the sentient nerves is greatly heightened, and the general metamorphosis and muscular tone stimulated, still no injurious effects are perceived from the carbonic acid, unless some contra-indicating circumstances forbid the use of this form of bath. An extremely pleasurable sensation is created by the water constantly moving to and fro with white foam and hissing. But the titillation produced by the sieve-like douche is certainly the most agreeable sensation that can be imagined, and must inevitably be of great therapeutic value in many diseases of the nervous and sero-fibrous system. A different result is also expected from applying the douche under the water, when the force is diminished, or beyond the level of the bath. The douches are generally followed by the use of rubbing brushes.

The 'Soole' is further made use of for a natural 'vapour-bath.' In consequence of the fall of thirteen feet, to which it is subjected, at this distance (thirty-six roods from the bore-hole), it rises in a shaft to the height of twelve feet, and constantly splashes over, filling the chamber (in which the shaft is enclosed) with exhalations of saline ingredients and carbonic acid, the latter tending to move towards the bottom from its gravity, whilst the former remain suspended in the upper strata of the room, exercising their grateful influence on the respiratory organs. The chest seems inclined to expand more freely, with a certain feeling of ease, and to inhale a greater quantum of air. Though the temperature of the room be from 22° to 24° R. = 81° to 86° F. (or lowered to 17° R. = 70¼° F., by opening the window-valves, at the ceiling, if required), no oppression or inconvenience is perceived from the heat: in fact, I could only *perceive* the increased temperature, when, coming into the air, I felt the contrast of diminished heat. But in the room the temperature appears perfectly congenial to the physical perception. For drinking, imported or factitious mineral waters are used to assist the external treatment; also the 'bitter-brunnen' mentioned above, is occasionally employed.

The *weaker* 'Bulow-brunnen' (containing, in 16 ounces, 180 grains of chloride of sodium, 16 grains of sulphate of soda, 7 grains of carbonate of soda, $4\frac{3}{4}$ grains of carbonate of magnesia, $6\frac{1}{2}$ grains of carbonate of lime), is separated from the stronger 'Soole' for occasional use. The air of the neighbouring salt-works is also made use of for sanitary purposes. The strong 'Soole' of the 'Bulow-brunnen' is dispersed over the thorny walls of the graduation works. The different layers are composed of various precipitates from the dripping saline mass. This 'Soole' contains, in 16 ounces, 825 grains of solid constituents—viz. 754 grains of chloride of sodium, 22 grains of chloride of magnesium, 25 grains of sulphuret of calcium, 19 grains of sulphate of soda, $\frac{9}{10}$ths of a grain of carbonate of iron, 1 grain of carbonate of lime, $\frac{9}{10}$ths of a grain of resin and extractive substance. In *catarrhal affections* of the air passages, in *emphysema* of the lungs, &c., deeper and more calming inspirations are produced, to the great relief of the patient. The tone of the respiratory muscles seems to be increased, and the irritation diminished. The salt obtained at the chemical manufactory, from the mother-lye of the salt-works, contains, in 16 ounces, 261 grains of chloride of sodium, 4874 of chloride of magnesium, 630 grains of sulphate of soda, 172 of sulphate of magnesia, 19 grains of bromide of potassium and of magnesium, and 1531 grains of hygroscopic water. This mother-lye is externally applied, with great advantage, in glandular enlargements.

As regards the effects of the baths: the pressure of the water exercises a mechanical stimulus on the tissues and vascular rete of the skin, and promotes the power of imbibition, whilst its motion peculiarly stimulates the nervous system. The greater the mobility of the water, the more carbonic acid is evolved. The constant renewal of the water during the bath must also act very beneficially, as a much greater quantity of active remedial substances comes in contact with the absorbent vessels, with unchanged temperature, and unvarying constituents. Neither heating nor cooling being required, any loss is obviated that might arise by the escape of carbonic acid, as well as the precipitation of oxide of iron or other bases, held in combination with the acid. Chemically considered, the 'Soole' is distinguished by its abundance of carbonic acid and of carbonates. In 13½ cubic feet of water (the quantum of one bath), 37 pounds of solid ingredients, and 10 cubic feet of carbonic acid exercise their influence on the bather. The constant renewal, of course, considerably increases this quantity. The constituents may either produce direct changes in the various tissues of the body, by affording restoratory stimuli, or enter into immediate combination with the diseased substances (as lime or magnesia in diseases of the osseous system, iron in a deficient state of the blood-krasis), or may promote absorption and resolution of exudated matters, or excite certain secretory and excretory organs to an increased function. The layer of carbonic acid on the surface of the bath, mixed with atmospheric air, and the exhalation of the saline ingredients, seem to exercise a calming influence on the air passages. The tone and mobility of the muscles and muscular organs is invariably heightened. The muscular tissue becomes denser, morbid perspirations diminish; the *skin loses the great sensitiveness towards changes of temperature*, and the nervous centres regain in many instances their lost energy, by an appropriate use of the baths. It is maintained that the mental and physical functions, depending on the integrity of the central nervous system, are restored to their normal condition, if no organic derangement forbids the use of the spa. There is one peculiar evil for which Dr. von Möller considers this spring as an unfailing specific—viz. the *too rapid growth* and incomplete development of young persons *with hereditary phthisical disposition*, and already beginning signs of the impending calamity. Oeynhausen restores the equilibrium by causing the muscular system to be more invigorated and developed, and the thoracic organs to be strengthened by the influence of the saline exhalations. If employed to excess, or under contra-indicating circumstances, lassitude, depression, headache, giddiness, want of appetite, restlessness, &c., will be the consequence of bathing. On the other hand, the cures on record did not invariably ensue after using some baths, nor even after completing the course, but, in many instances, some weeks or months after the patients had quitted the place, and perhaps under a feeling of disappointment. In fact, it is considered as a more favourable sign, if the disease remains apparently stationary during part of the course, or if momentary aggravation of certain symptoms mark the influence of the spring on the affected parts. Bath eruptions are rare. I omit the directions for the various modifications, in which the soole-baths and vapour-chamber are to be used, for these must be determined by the difference of the diseases and other circumstances. The duration of the bath is from five minutes to half an hour. After a few weeks an interruption of some days is recommended. Baths of long duration are more easily borne by children than by adults. Signs of saturation, lassitude, anorexia, depression, pains in different parts of the body, chilliness alternating with heat, oppression of the chest, &c., require an immediate discontinuance of the bath.

In order to enable the physician to recognise the complications, in which this spa affords peculiar chances of recovery, I shall detail some of the cases furnished by Dr. von Möller, so as to illustrate the peculiar efficacy of Oeynhausen. For however similar or analogous various springs of the same class may appear, the careful observer will find that each spring stands in a peculiar specific relation to a certain complication of morbid phenomena, which it is able to remove, whilst a slight deviation of this complication may indicate the employment of another spa. This might not only be inferred from the varying chemical composition, but from the dissimilarity of atmospheric, climatic, and other influences. And if we have to use the nicest discrimination in the ordinary choice of medicines—if one anti-rheumatic, one anti-phlogistic, one anti-febrile, causes no amelioration of the respective diseases, and compels us to resort to other expedients, primarily less indicated—how much greater must be the difference in the effects of remedial agents, the full qualities and often the complete chemical constituents of which are not yet thoroughly known!

A gentleman, fifty-two years of age, exposed to many bodily exertions and changes of temperature, probably also indulging in spirituous liquors, suffered for some time with intestinal catarrh, vomiting of water in the morning, obstruction, *paralysis of both arms and legs*, and general trembling, particularly in the neck, hands, and knees; violent throbbing pains in the forehead and occiput and absolute insomnia. Twenty short baths, with interruptions, and internally Selters-water with Carlsbad salt, freed him from the above-mentioned severe complication of morbid symptoms.

A girl of fifteen years is mentioned, resembling in physical appearance a child of twelve, emaciated and pale, of feeble muscles, with a flat, narrow thorax, and disposition to febrile symptoms, hæmoptysis, palpitation of the heart, and other signs indicating *incipient tuberculosis*. She took short 'quiet baths,' with intermissions; was exposed to the exhalations of the vapour-chamber, and to the air of the graduation works. Internally, simple whey at first, and afterwards with an addition of Franzensbrunnen water. After six weeks, the respiratory organs and general nutrition of the muscles assumed a very improved character, and a year after the course, the body was normally developed, with a tendency to corpulence.

A merchant, thirty-six years of age, married; through early excesses, affected with impotency and frequent seminal discharges at the slightest sexual excitement; dull pains in the occiput, emaciation, general debility, coldness of the hands and feet, violent pains in the lumbar regions at night, with chilliness and subsequent profuse perspiration, deep depression, loss of memory, restlessness, inability to follow a connected train of thought, or to write letters requiring mental exertion, &c. He used quiet baths for four weeks, and drank Franzensbrunn water. The muscular system gained gradually in strength, the pains of the head and loins, with the accompanying symptoms, diminished, the genital system lost its abnormal erethism and returned to its ordinary condition, and the mental faculties became restored.

Swellings of the spongious ends of bones, with distention of the synovial sac, and muscular atrophy, have been removed by long baths with flowing water, whilst internally Marienbad Kreutzbrunnen, and afterwards Homburg Elisenquelle were taken. Chronic inflammation of the knee-joint, with contraction and stiffness, and even carious exfoliation, are said to have been cured or relieved by this Spa.

Cases of rhachitis scrofulosa, osteomalacia, &c., are also reported, in which the baths afforded great relief, particularly with children.

Mr. Papst, of Petershagen, reports several cases of *hypertroph. uter.*, hydrops ovarii, &c., which he brought to a successful termination by the spa Oeynhausen, in connexion with other remedies; viz., in robust persons, with swellings and pain of the womb, he applies eight leeches twice a-week; afterwards a bath is ordered, then a ball composed of equal parts of grey mercurial ointment, lard, and yellow wax, is introduced into the vagina, so as to touch the collum and os uteri. This is renewed after twenty-four hours. Afterwards he substituted iodine ointment for the mercurial. Internally he employed, according to circumstances, either tonics, solvents, or iodine. In Oeynhausen he ordered baths from a quarter of an hour to be gradually prolonged to an hour. Then an injection of the soole, four times a-day, besides some tumblers of it morning and evening internally, with proper diet and exercise. He details several instances of severe *subacute inflammation* and *swellings* of the *uterus* and *ovaries*, which were cured or relieved in the above manner.* The *vapour-*

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* To mention one instance:—Mrs. T., thirty-eight years of age, married, without children, had suffered several years with pain and pressure in the pelvis, obstinate obstruction, and frequent retention of urine. The menstruation accompanied with the most violent pains, and very abundant. The exploration per vaginam showed the neck of the uterus flattened, the os uteri directed backwards, and the uterus swollen to the size of a child's head, with several protuberances at its posterior wall; it was scarcely moveable; urine could only be discharged by the help of the catheter. The above men-

chamber, which may be considered a remedy of itself, requires a few words of further notice. The constant precipitation and renewal of warm saline exhalations with carbonic acid, exercises such a soothing influence on the mucous membrane of the thoracic organs, that whenever increased respiratory movement, or entrance of fresh air, produces cough, pain, or oppression, these distressing symptoms will be unperceived or diminished in this chamber. If we consider how many diseases of the chest are connected with pulmonary catarrh, and what aggravation may ensue through impeded inspiration and consequent obstructed discharge of the venous contents, the favourable influence of this vapour may be readily imagined. Whether the good effect be due to the increased tone of the capillary vessels, or to the sedative power of the vapour, or to the absorption of the dissolved particles into the circulating fluids, must remain undecided for the present.

Patients with hoarseness, tickling in the throat, impeded deglutition with irritation and cough, chronic inflammation of the follicles of the mucous membrane of the larynx, and tendency to ulceration and incipient laryngeal phthisis, are said to have been cured by the sole use of this natural vapour. The voice and thoracic muscles are exercised in the chamber. Whey-cures are often combined with the vapour course, and equestrian exercise recommended. The catarrhal affections resulting from *hooping-cough* are particularly asserted to be often cured by this remedy. A case of *tubercular phthisis* is reported of a girl of thirteen years of age. Parents of arthritic diathesis. The child was brought up in the country, and appeared well fed, but had suffered with bronchial catarrh since her childhood, also *enuresis nocturna*

tioned plan of treatment was adopted, and after three months the bladder and rectum performed their functions normally, the mouth and neck of the womb could again be discerned, the swelling had almost disappeared, the organ again occupied its normal position at the upper part of the pelvis in its middle diameter, was easily moveable and less sensitive. Menstruation now unaccompanied with the former pain, and of moderate abundance; the patient was discharged as cured after this period.

to the end of her twelfth year. In the autumn of 1848, after an attack of scarlatina, circumscribed pneumonia and pleuritic affection were superadded to the bronchial catarrh, besides emaciation and diarrhœa; the thorax ceased to expand to its normal extent, consonant and cavernous rhonchi were discovered by auscultation, and corresponding dulness and tympanitic sound by percussion. Considerable dyspnœa and debility were exhibited on any attempt at exercise; voice hoarse, cough violent and continuous; expectoration tough, purulent, granular, and often mixed with blood; fever, with evening exacerbations and profuse perspirations. This was her state after eight months of suffering. She used the vapour bath twice a-day from one to two hours, with interruptions, and as soon as her muscular strength was sufficiently improved, she spent the greater part of the day near the graduation works. Complete recovery ensued. The right subclavicular region, depressed to a considerable extent, only raises itself towards the end of a very deep inspiration. Physical examination showed, after a year, partial condensation of the pulmonary substance, containing vesicular tissue, but no subjective signs of disease.

The chemical analogy which the ‘ Soole’ bears to sea-water (with, however, more common salt and sulphate of potash, and less magnesia), must prepare us to find *improved nutrition* amongst its chief effects. From the circumference the stimulus to increased energy must be transmitted to the nervous ganglia, inducing resolution and absorption of abnormal productions, and a freer action of the lymphatic system.

Different forms of *scrofula* claim, therefore, the first place in the category of diseases to be subjected to its influence. The carbonate of *iron* and of lime, and the abundance of carbonic acid, which distinguish its composition, open another sphere of action in the group of human ailments. We find in our daily experience of *sea-baths,* that they restore the tone of the muscular system, increasing the contractile power of the blood-vessels, ameliorating the functions of the glandular organs, removing the obstructed condition of the dermic follicles, eliminating morbific substances by the increased exhaling power of the skin, and indirectly raising the strength and condition of the cerebral and spinal nervous system.

But in many instances, when their useful application is impracticable, from the violent reaction they produce in the nervous system, this spa might form an excellent substitute, particularly with very sensitive, anæmic, and debilitated individuals, who require for their cure both stimulating and integrant curative agents. Hence the great utility of Oeynhausen in many forms of gout, rheumatism, and arthritic paralysis, *with muscular atrophy.*

The advantages of the vapour chamber in irritation of the thoracic mucous membrane and the subcutaneous follicular tissue, are too obvious to require further comment; and though some enthusiastic appreciation of the spa may be imagined on the part of the resident physicians, still its physical and chemical properties fully justify us in believing that it possesses a considerable curative power in combatting many chronic diseases, otherwise intractable.

During the bathing season the visitors may avail themselves of the medical services of Dr. Schober, from Vlotho, and Surgeon Luckardt, besides those of Dr. von Möller, who constantly resides at the Spa.

Nauheim, another spa of recent discovery, is distinguished by a remarkable phenomenon, called the 'Soolen Sprudel,' a pyramid of white foam, bubbling up to the height of two or three feet above the surface of the spring from which it rises.

The place has been favourably known for many years through its excellent salt-works; it is situated at the south-eastern declivity of the Johannisberg, 670 feet above the level of the sea, within the distance of half a league from *Friedberg,* which town is connected by railroad with Frankfort-on-the-Maine, and may be reached from the latter city in an hour. The direct journey from London would occupy about forty-four hours. When arrived, we see a pleasant village, with 1500 inhabitants, and the little river Usa meandering through the surrounding fields.

A large and deep pool, with two isles, forms the northern boundary; to the east, a small mountain ridge is perceptible; to the south, the plain extends as far as Friedberg. Giessen lies about six leagues to the north, and Frankfort the same distance to the south. Behind the Johannisberg rises the Winterstein, with luxuriant foliage. The graduation works extend to the other side of the high road. The white, grey, and reddish quartz of the Johannisberg is interspersed with single strata of talc, which form a transition into clayey talc slate, by receiving clay and quartz. In the Usa valley these are superposed by clay, argillaceous sand, and ferruginous nodules.

The thermal saline springs of Nauheim flow out of the rugged transition strata on both sides the Usa, and partly in the Usa itself from the north to the south. Several of these have been allowed to fall into decay, on account of the power and abundance of the Artesian wells, about to be described.

In the year 1823, the Artesian well No. 1 was bored; it is sixty-two feet deep, and yields 8600 cubic feet of 'soole' per day, of 1·021 specific gravity, and of the temperature of 25° Reaumur = 88¼° Fahrenheit, with a great quantity of free carbonic acid. Formerly, the water was conveyed by subterranean pipes into the 'Kurhaus' for bathing.

The Artesian well No. 2 was bored in 1824, to the west of No. 1; the spring was found at the depth of eighty-five feet, and daily supplies 15,000 cubic feet of 'soole,' of specific gravity 1·021, and of the temperature of 21° Reaumur = 79¼° Fahrenheit. It contains 10½ cubic inches of free carbonic acid in sixteen ounces.

The most prominent feature of the spa, *'the Soolensprudel,'* flows from the *Artesian well No.* 5, which was bored in 1838 to the depth of 114 feet, to the east of No. 1, and near the shore of the Usa. For several weeks the 'soole' filled the borehole, sometimes overflowing and at other times receding. In order to pump it up from the hole, a tube was introduced on October 1st, 1838. Scarcely had the pumping been continued for a few minutes, when the spring burst out with great violence; bubbling up with roaring and hissing, it threw the foam sixteen feet above the surface, spluttering and hurling small stones and sand in all directions. After some hours the tumult ceased, and the spring only bubbled up a few feet over the hole. The next day it disappeared entirely, so that the pump had again to be used. An intermittent action was then observed; for about ten minutes the water arose to a height of from twelve to fifteen feet, blustering and roaring, and then sank back again to the level of the borehole; by degrees it became regulated, and now it invariably bubbles up to a height of two or three feet above the surface, bearing at a distance the appearance of a white column resting on the ground. By fixing a narrow tube to the mouth, this column can be made to rise fifteen or twenty feet. After the tube has been applied for some time and then removed, the 'sprudel' gradually rises with stronger and stronger concussions of the ground, which are perceptible to the by-standers. Higher and higher the splashing and hissing foam is thrown; the water, formerly transparent, now becomes turbid, and carries up with it small stones of the size of a walnut; the 'sprudel' then resembles a beautiful pyramid of white foam; the subterranean shocks then gradually die away; the pyramid becomes smaller and smaller, and is soon reduced to its ordinary height of two or three feet.

Another very important circumstance connected with this spring is the abundance of carbonic acid; the shaft is often filled at its open end with a layer of warm carbonic acid, to the height of five feet. A person descending, distinctly perceives the commencement of the layer, by a sensation somewhat resembling that of dipping the hand into warm water. 14·9 cubic feet of pure carbonic acid flow out of the hole every minute, being equal to upwards of seven millions of cubic feet per year (exceeding one million pounds in weight); the temperature of 25° Reaumur = 88¼° Fahrenheit, is another great advantage, for no change or decomposition need be apprehended, the inherent warmth being so congenial, that any process of heating or cooling becomes unnecessary.

The 'sprudel' yields daily 25,000 cubic feet of 'soole;'

of 1·023 specific gravity; the temperature was at first 26° Reaumur, but it gradually rose to 27° Reaumur = $92\frac{3}{4}$° Fahrenheit, and then remained stationary; this elevation of temperature has also been observed in the other springs. The temperature of No. 1 was in the year 1823 only 21° Reaumur, and is now 25°. The water of the Soolensprudel is conveyed by subterranean pipes into the Kurhaus, and serves for the preparation of baths.

The Artesian well No. 6, or 'Kurbrunnen,' was bored some hundred feet to the east of the Sprudel, on the other side of the Usa; the spring appeared at a depth of sixty-six feet, materially differing from the others in the quantity of the various ingredients.

The spring yields 1500 cubic feet of water per day, of 1·007 specific gravity, and 18° Reaumur temperature ($72\frac{1}{2}$° Fahrenheit). Besides the carbonic acid ($17\frac{1}{4}$ cubic inches), it contains half a cubic inch of nitrogen; the water is clear, sparkling, and transparent, and has an agreeable acidulous, pungent, and saline taste. The Kurbrunnen is also subject to a periodical but irregular flow, sometimes sparkling and overflowing, and at other times, again, scarcely reaching the level of the borehole. Analysis of the springs by Professor Bunsen shows—

Contents of the Nauheim springs.

	Art. Well No. 1.	**Art. Well No. 2.**	**Art. Well No. 5. Soolenspr.**	**Art. Well No. 6. Kurbr.**
Chloride of sodium	195·4 gr.	191·54	207·78	59·57
„ potassium	2·22	2·99	trace	trace
„ magnesium	2·31	4·60	2·82	0·35
„ calcium	14·89	15·85	17·34	2·73
Bromide of sodium	0·15	0·23	trace	trace
Bicarbonate of lime	17·21	16·63	16·99	12·26
„ iron	0·75	0·84	0·10	0·40
„ manganese	0·08	0·09	0·02	0·12
Anhydrous sulphate of lime	0·58	0·48	0·53	0·27
Silex	0·14	0·17	0·1	0·01
Organic substance	trace	trace	trace	trace
Total	233·78	233·42	245·78	75·74
Carbonic acid		$10\frac{1}{2}$ c. in.	$13\frac{3}{4}$	$17\frac{1}{4}$

Kreuznach possesses the advantage of containing iodine, and therefore exercises peculiarly curative powers in the diseases of the glandular and lymphatic system, and in many pseudo formations; but Nauheim has to be selected in many instances from its warm temperature, the great abundance of carbonic acid, the greater quantity of chloride of sodium, of calcium, &c.; and especially from its carbonate of iron and of lime. The springs of Nauheim are used both as baths and internally. For the latter purpose the Kurbrunnen is used, which is cooler, less abundant in salt, and more easily to be assimilated. Though no effect can be expected without perfect assimilation, which latter will certainly be more promptly performed by introduction into the intestinal canal, experience shows, that in many instances, the external application is preferable, from its producing a milder and yet more penetrating effect, and causing a more uniform stimulus of the general functions of the body. Sometimes the internal administration of the ‘soole’ produces too great an irritation of the intestinal canal. In other instances, the cause of ailment may lie in the disturbed function of the cutaneous system itself, requiring the external stimulus of the spring for the elimination of the morbific matter. On entering the bath a sensation of chilliness is at first experienced, probably in consequence of the mechanical irritation which the saline particles exercise on the epidermis. After this momentary retrocession of blood, reaction ensues, and the circulation soon tends with heightened energy towards the circumference, and creates warmth. The abundant admixture of carbonic acid no doubt assists in producing this irritation, for at every movement made in the bath, small air bubbles attach themselves to the surface of the body; these contain carbonic acid, which comes into contact with the nervous ramifications, and transmits its stimulating power to the central nervous system, producing increased vital action. By the absorption of the saline particles into the blood, greater freedom of circulation is created, the morbidly heightened sensibility of the nervous system is diminished, and thus the necessary equilibrium restored. After the bath, bodily and mental vigour appear increased. The temperature of the bath must be regulated with great care, according to the individual requirement of the patient; for when the inciting property of the carbonic acid is assisted by too great a heat, powerful irritation and congestion may be produced, instead of a beneficial harmony between the vascular and nervous systems; such as oppression of the chest, palpitation of the heart, headache, humming in the ears, giddiness, &c. Even in the cooler baths, the sensation of heat appears to be a few degrees higher than the real temperature. Generally between 22° and 26° Reaumur is the most useful temperature, and only great torpor and relaxation of the external skin, extreme nervous debility, morbid enlargements and indurations require a powerful stimulation of the absorbent system, and the temperature may then be raised to 28° Reaumur (95° Fahrenheit). In such cases, motherlye* from the salt-works is added to the bath, to increase its efficiency. It produces a gentle sensation of burning on the skin, the intensity being in exact proportion to the quantity of lye added. The first baths are taken without lye, then small quantities of the latter are added, till that sensation appears, then the quantity is gradually decreased again. But if it be added too soon, or in too great proportions, an erysipelatous inflammation is sometimes produced during the first day's application, which is so far from being beneficial, that the course must be stopped for some time. The particles contained in the water are imbibed by the veins and absorbent vessels, and arrive at the organs of sanguification, destroying or neutralizing the elements of dyscrasia, and being conveyed to the different organs, they produce increased absorption and secretion, and accelerate reproduction of organic matter. An increased uropoietic function is at once perceptible, but the chief efficacy is displayed in the *lymphatic and glandular* systems by removing morbid deposits and enlargements; and here Nauheim becomes particularly valuable through its bromine and chloride of calcium. In the mucous membranes the secretions are promoted; where tough and adhesive expectoration produces irritation and cough, looser mucus becomes expectorated, and thus the respiration is freed. The mucous membranes of the female sexual system are also strengthened, and the treatment is assisted by injections; chronic swelling and indurations of the generative organs are often absorbed and resolved; obstructed or painful menstruation becomes regulated, and the appetite is generally increased; also exudations in the joints, and thickening of the synovial membrane, even exudations in the cranium, producing paralysis of certain parts by pressure on the brain, are said to be removed by increased vascular action of the abdominal organs. If the epidermis be morbidly dry and tense, the warmer baths are indicated with motherlye, but if the skin be more relaxed and inclined to profuse perspirations, the cooler, more gaseous baths are to be employed, assisted by cold affusions and douches. Bath eruptions may appear in different forms, generally preceding a speedy cure, but by no means a necessary consequence. For baths the 'Soolensprudel' is used, which cools sufficiently on its way to the Kurhaus to afford a medium temperature; if more stimulus be required, some 'soole' is added. The Sprudel excels as regards the prevalence of salts and free acid, while the well No. 2 has the advantage of possessing more bromine and carbonate of iron. Its temperature being 21° Reaumur, it might be advantageously mixed with the 'Sprudel,' particularly where less solvent and more tonic and stimulating action is required.

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* The liquid left in the boiling pans, after common salt has been separated in its usual crystalline form. Thus it contains the constituents of the soole with the exception of culinary salt—viz., bromine, chloride of potassium, of magnesium, and of calcium.

The Kurbrunnen, with 18° Reaumur ($72\frac{1}{2}$° Fahr.), mostly acts, when taken internally, as an aperient, diminishing the mucosity of the primæ viæ, promoting the liquefaction of obstructing conglomerated substances in the portal system, and in the hæmorrhoidal and uterine vessels. Whilst, on the one hand, the chloride of calcium and potassium, and bromine, act powerfully on the intestinal mucous membranes, and on the glandular system, the carbonate of iron prevents a greater liquefaction than necessary to resolve enlargements. Stools without griping or inconvenience generally ensue, unless some errors of diet have been committed, when pressure and pain in the abdomen, with distention, headache, chilliness, &c., and watery evacuations, with colic or obstruction, will be the consequence. Sometimes confinement of the bowels is observed at the beginning of the course, but after some time, when the morbid deposits have become moveable and liquefied, so that a smaller quantity of the saline particles requires to be absorbed into the organic fluids, copious evacuations ensue on a sudden (without apparent cause), of an acrid, bilious character, and with distinct critical properties. General improvement is then an invariable consequence. If increased alvine action is required, the Soolensprudel is mixed with the Kurbrunnen, or given by itself (*when it always acts as a violent purgative*).

The carbonic acid gas, which streams with such abundance out of the borehole, is received by an inverted tun, and partly conducted into an apparatus near the shaft of the well, and partly into a little house near the spring. The former resembles a sweating-box, the head being out of the bath whilst the carbonic acid enters from two holes at the bottom. In the little house two rooms are erected; in the one gas-baths are exhibited as in the above-mentioned box, and in the other the gas streams out of an elastic tube, which serves for local douches on the eyes, ears, &c. Undressing is not required in the gas-bath, because the carbonic acid penetrates the cloth, and expels the atmospheric air from the surface of the body. A peculiar feeling of warmth and pricking is experienced on the skin, especially at such parts as are but thinly covered with epidermis. By staying for some time, the warmth increases, causing sometimes even perspiration in very susceptible persons. Its entrance into the lungs is prevented by the spasmodical closing of the epiglottis. If imbibed with atmospheric air, it causes oppression in the chest and inclination to cough, unless much diluted; but received into the digestive organs, it acts beneficially, producing an agreeable feeling of warmth. Pressure and tension of the stomach from drinking the Kurbrunnen, spasms of the stomach, flatulence, &c., immediately disappear after swallowing some gas. Applied to the dry epidermis its effect is more dynamic on the sensitive cutaneous nerves, and generally only perceived during the application.* By means of a moist medium, however, it becomes imbibed into the animal juices, and acts as an antiseptic, not condensing the liquids (as is done by the fixed acids), but, as it is supposed, by stimulating the capillary vessels, it causes increased secretions, and thus counteracts putrefaction, by increasing the vitality of the absorbent vessels. It is, therefore, less useful where putrescence has taken place, than where tendency to decomposition is commencing in the capillary vessels. Whilst, on the one hand, the gas-baths reproduce sanguineous secretions or hæmorrhages, by the same power they exhibit a curative action in *morbus maculosus Werlhofii,* and prevent further ecchymoses. The gas has the tendency to act as an aphrodisiac in males, and to increase the power of conception in females. In pregnancy, abortion is apprehended from its use. As a local douche it is very useful in leucorrhœa, by improving the morbid condition of the mucus and the tone of the secretory surface. It also somewhat ameliorates the secretion of atonic and varicose ulcers, and accelerates their cure. The invigorating and enlivening effect experienced after the bath, particularly by enfeebled or aged persons, is thought to be due, in a great measure, to the presence of the carbonic acid gas, which, by its stimulating effects on the peripheric nerves, causes the rigid muscles to become more pliable. By the increased metamorphosis, passive congestions, which often become so dangerous in old age, may be removed.

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* That the carbonic acid may sometimes exhibit very marked efficacy is shown by the following instance:—A joiner, twenty-eight years of age, was seized with abdominal typhus. When he approached towards convalescence, he was suddenly affected with violent pains and inflammatory swelling of the right shoulder joint. The next morning the left shoulder became similarly affected; then the elbow-joints and wrists. Anti-arthritic treatment produced abundant crises through skin and kidneys; the swellings diminished, the hands and forearm could be moved without pain, but the shoulder joints remained immoveable, and the slightest attempt to move the upper arm created violent pains; the patient became emaciated, the bones seemed barely covered with a dry, tense, and parchment-like skin, which, by its icteric colour, showed the liver to be affected (perceptible enlargement of this organ was also present). Digestion prostrate, stools only ensue through clysters and opening medicines. The season approaching, under these circumstances, Dr. Bode recommended with confidence the soole-baths, but, unfortunately, they only increased the disorder, and had therefore to be discontinued. With some diffidence, Dr. Bode then tried the dry gas-baths. The weakness of the patient scarcely allowed him to drag himself to the well-shaft, but in the gas he found himself perfectly free from pain. All medicines were discontinued, and merely the gas-baths employed. In the third week, copious diarrhœa ensued, with fetid evacuations, and at last with some blood, which stopped spontaneously after a few days. The relief progressed steadily and uninterruptedly. Then the soole-baths were given and well borne, and completed the cure.

Amongst the diseases for which Nauheim is especially recommended, *scrofula* takes the chief place. In this peculiar dyscrasia, produced in the capillary system of the blood-vessels, the blood becomes abnormally altered, and unfit to supply those particles consumed or lost by organic metamorphosis. All tissues being gradually formed from this deteriorated material, it is natural that the organs of the reproductive system must be chiefly affected, drawing other organs into the cyclus of derangement.

Iodine, however useful in hypertrophy of parenchymatous organs, is often found unavailing in osseous swellings and scrofulous ophthalmia. Different mineral and vegetable substances have been employed at various times with some advantage, in certain forms of the disease. But in many complications of scrofula, Nauheim deserves a decided preference from its combination of chlorides with bromide, iron, and carbonic acid, and from the easy assimilation of the water. Many children have been cured of their scrofulous habit, and of phthisical tendency. Nauheim shows itself particularly useful in scrofula of the mesenteric glands, with a distended and hardened abdomen, emaciation, pallid and puffed up complexion, deranged digestion, obstruction alternating with diarrhœa of acrid fetid evacuations, tendency to mucosity, to helminthiasis, and in *retarded development*, connected with precocious appearance, &c. In very young children, equal parts of Kurbrunnen and milk are administered; sometimes decoction of *malt* is added with great advantage to the baths. If the disease has lasted beyond puberty, it becomes more obstinate, though less dangerous.

Resolution of glandular swelling sometimes begins during the course, under the appearance of furuncular bath eruption, then stops apparently, and is often completed some time after the patient leaves the spa. Scrofulous ulcers are sometimes made to assume a healthier appearance, and to become more amenable to ordinary treatment.

In cutaneous diseases, based on scrofula, the soole-baths are very useful; mixed with motherlye, they are said to have rendered excellent services in cases of lupus and ulceration of dermic tissue; scrofulous affections of the respiratory organs are likewise benefited by the spa. Bronchial mucosity becomes dissolved and loosened by the Kurbrunnen. Confirmed phthisis will of course not be benefited by the springs, but when tubercular matter is forming in the blood, its deposition in the pulmonary tissue is said to be prevented by an early use of the 'soole,' which may be supposed to dissolve the coagulable albumen (forming the tubercular matter), and to loosen the viscid mucus, which obstructs the bronchial ramifications, and thus free the circulation of an impediment which might dispose to tubercular deposit. This tendency is further counteracted by the increased abdominal functions, which consequently diminish the dangerous pulmonic obstruction and congestion. Indirectly, the soole-baths are beneficial in this disease by strengthening the skin and removing the tendency to catarrhs, which sometimes induce the development or deposition of tubercles. The air of the graduation works acts as a powerful adjunct, even causing the healthy to respire with more ease. Tubercular disease is very rare amongst the inhabitants. Nauheim is also very efficacious in scrofulous ophthalmia; the photophobia and characteristic ulcers of the cornea are said to disappear in a very short time, without leaving spots; maculæ become also sometimes absorbed; the spa is less useful in palpebral inflammation.

Scrofulous otorrhœa is benefited by douches of carbonic acid and injections of 'soole' into the Eustachian tube. The bath also showed itself beneficial, according to Dr. Bode, in scrofulous diseases of the joints—viz., softening (rhachitis), or chronic inflammation without softening, but with necrotic mortification of pieces (spina ventosa), or loosening and swelling, with a tendency to carious ulceration (pædarthrocace).

Some curative power is also attributed to the Spa in chronic abdominal diseases, with hæmorrhoidal tendency. It diminishes the venosity of the blood, and thus helps to remove obstructions of the portal system, and of the glandular abdominal organs. Its solvent power is exercised in so gradual a manner, that cerebral congestion is not to be apprehended. By re-appearance of suppressed piles, physconia of the liver and spleen frequently disappeared. The soole-baths also exercise a very beneficial influence on catamenial derangements, produced by congestion or obstruction of the uterus and ovaries. The soole acts as a decided *emmenagogue*, and is greatly assisted in this respect by the carbonic acid. On the other hand, profuse menstruation, with colic and other nervous symptoms, is diminished. Young persons, in whom the regular appearance of menstruation is retarded or occasionally omitted, are particularly recommended to use the baths, which are said to be equally useful in the epoch of cessation of period, and in the many derangements based on the omission of this habitual outlet; for they are able to remove local congestions by increasing the normal functions of the secretory and excretory functions.

Their utility in gout and rheumatism may be inferred from the properties already detailed.

But, Gentlemen, though the temperature and ingredients of the Spa may fully justify a belief in its superior efficacy as regards the above diseases, in which Dr. Bode confidently recommends it, and though its rapidly rising estimation with the public seems to confirm these statements, still the former difficulty is presented to us of choosing the most appropriate Spa in given cases. For you must be aware, that some of the diseases enumerated will have a better chance of recovery in other Spas. Even in scrofula itself, the question must frequently arise whether you have to recommend to the patient Kreuznach or Neuheim. Whenever in parenchymatous swellings or indurations of glandular organs you require the powerful intense action of iodine and chlorine both internally and externally, you have to select *Kreuznach,* where the happy combination of ingredients allows its use in drinking and bathing as the most powerful anti-scrofulous alterative. If an internal imbibition of iodine and bromine be chiefly required, with a smaller amount of solvent chlorides, but with some carbonate of soda to act against such forms of scrofula as are connected with profuse acidification, vesical or uropoietic irritation, abnormal enlargement of certain generative organs, &c., you will give the preference to *Adelheidsquelle* of Heilbrunn. But if the state of your patient be such that you expect the greatest benefit from calling into requisition the powerful action of the cutaneous system, if you would wish to increase the functions of the peripheric absorbent vessels by warm baths, which do not create cutaneous relaxation, but, on the contrary, combine a tonic and solvent agency with this increased peripheric function, you have to choose Nauheim. The same applies in scrofulous diseases of the joints, in catamenial deficiency, in the case of girls with a retarded development of maturity, of a tense and harsh epidermis; in rheumatism and gout produced by repressed perspiration, especially in scrofulous individuals; in scrofulous diseases of the organs of the senses, &c. You have here a greater quantity of carbonic acid and of iron than in any other of the anti-scrofulous Spas. Thus, whenever you wish to combine the powerful stimuating gas and the restoratory strengthening iron with the antidyscrasic chlorides and bromides, you have also to select Nauheim. Its utility in preventing tubercular deposits is shared by most saline springs, and has been explained on a former occasion. But how are we to choose between Oeynhausen and Nauheim, both children of the modern epoch, both results of boring trials, both attached to salt-works, both offering nearly the same temperature and very similar ingredients? The answer to this question will again confirm the statement I have had so frequent occasion to make—viz., that the chemical constituents must not be solely relied upon for determining the therapeutic value of a Spa. For however similar the two modern competitors for fame may be, the few contrivances mentioned, when speaking of Oeynhausen, impart to the latter Spa such peculiar efficacy in certain pulmonary diseases, that its anti-scrofulous ingredients almost recede into the background. I allude to the vapour-chamber. Further, the manner of filling the baths from below by pressure (as described), and the different local agencies that may be brought to bear on the affected cutaneous nerves by the various modes of filling; all these contribute to deviate from its originally destined application, and to render it useful in thoracic and neuralgic complaints, for which it would not have been recommended if left to its ordinary resources. On the other hand, we must not disregard the chemical difference between the two Spas—viz., the greater amount of carbonic acid, the presence of chloride of calcium, and the absence of sulphates (with a slight exception) in Nauheim; whilst Oeynhausen possesses more chloride of sodium and of magnesium, and besides, it contains sulphate of lime and magnesia. It thus bears greater analogy to sea-baths; its iron is also more abundant than in the Sprudel of Nauheim. All this combines in rendering Oeynhausen a powerful, and I might almost say, unique remedy in diseases caused by *imperfect development* of the frame through a too rapid growth. However, to return to Nauheim. I will just allude to a neighbouring acidulous spring, which is often used in connexion with Nauheim—viz.,

Schwalheim, which lies about half a league to the east of

Nauheim, in the valley of the Wetter, near Dorheim. The chief well was reconstructed in 1831, and analyzed by Wurzen; latterly by Liebig, who found it to contain in sixteen ounces, 18·61 grains of solid constituents—viz.,

Chloride of sodium	11·94	grains.
„ magnesium	1·08	„
Sulphate of soda	0·62	„
Carbonate of magnesia	0·41	„
„ lime	4·31	„
„ iron	0·08	„
Silex	0·14	„
Traces of bromine and crenic acid.		
Total	18·61	

It contains besides, 22·72 grains = 49·44 cubic inches of free carbonic acid.

Its specific gravity is 1·002; its temperature 8·5° Reaumur = 51¼° Fahrenheit, summer and winter. If left exposed to the air for some time, a brown flocculent mass is precipitated, but in well-corked vessels the composition remains unchanged for years. Though 150,000 bottles are annually exported, a great part of the spring flows unused into the Wetter. The taste is piquant, agreeably acid, and cooling. It is often drunk with wine and sugar as a cooling beverage. It acts as a solvent and diuretic, and raises at the same time the sunken reproductive power. It is often drunk as an after-cure, when the course at Nauheim is completed. By itself, it is recommended in catarrh and hæmorrhoids of the bladder, in renal pains, and tendency to lithiasis. Taken in time, it may prevent the formation or progress of these diseases, calculi being unknown in this neighbourhood. In chronic bronchial catarrh it acts beneficially, if drunk with warm milk. In several forms of scrofula it is taken internally, whilst the soole-baths of Nauheim are employed, thus increasing, to a certain extent, the sphere of utility of the Nauheim water. But, as I stated before, the chief curative results are obtained at the modern Spa by its warm brine and carbonic acid baths. The great success and reputation of Dr. Bode will probably soon invite more and more colleagues to test the efficacy of the mineral water and to communicate their unbiassed conclusions to the medical public. For nothing will advance the prosperity of the Spas to a greater degree than to divest them of all mystery, and to state openly their advantages as well as their disadvantages. Too lavish encomiums have injured them more in the eyes of many rational and conscientious physicians than the greatest invectives could have done. Many have justly refused to employ a remedy recommended as a specific against a host of intractable diseases. Still, when all exaggerations have been carefully removed, when the grain has been sedulously sifted from the chaff, when nothing has been stated that will not admit of a rational and scientific explanation, this objection will certainly cease, and the Spas will be allowed to rank with the other remedies. Like those, they will not always produce the hoped-for results, but judiciously employed, they will often cure where pharmaceutic remedies fail, and thus frequently afford a further chance of recovery, when the cheering prospect of health is about to vanish.

Lecture XIX.

To-day, Gentlemen, let us inquire into the chemical constituents of the various springs. The combinations are all binary; no ingredient being present with a compound radical, if we except the organic substance occasionally met with under different denominations; as *Baregine* (found in Barèges, in France); *Theiothermine* (from θεῖον = sulphur, and θερμος, hot, because it is observed in various hot sulphurous springs); *glairine* (from *glaire*, mucus). It is either an accumulation of lixiviated and alluvial organic remains, or of different germs, combined into a flocculent mucous substance by coagulated albumen; or it contains the developed organizations of these germs. In order that living creatures may be formed in the water, its temperature must not exceed 40° Reaumur = 122° Fahrenheit.

The ingredients of the springs must, of course, be identical with those composing the crust of our earth. The water passing through various layers, dissolves, and carries off several particles, which are either soluble in water, or by means of substances combined with the water.

The elements composing the various ingredients are *electro-positive:* sodium, potassium, lithium, barium, strontium, calcium, magnesium, aluminum, manganium, iron; or *electro-negative:* oxygen, nitrogen, hydrogen, sulphur, chlorine, bromine, iodine, fluorine, phosphorus, silicum.

You will not meet with any substance in its elementary state, with the exception of nitrogen and oxygen, but all in the usual combination of oxides with acids, or of halogens with their basic elements, or of sulphides with sulphur bases.

Sodium (Na) forms the most important constituent in the saline springs (with chlorine); in the bitter waters (with sulphuric acid as soda), and in the alkaline, and many acidulous springs (with carbonic acid).

If soda (Na) be combined with carbonic acid, you have not to expect any other combinations in the water but carbonates; for soda being the strongest base after potash, would naturally expel weaker oxides out of their composition, and appropriate to itself the stronger acids.*

Suppose, for instance, you have a water with predominant carbonate of soda before you, you cannot find sulphate of iron in the same fluid; for the former salt would disunite the latter as soon as they are brought into contact. You see, by mixing the two solutions, the soda attracts through its stronger affinity the sulphuric acid of the iron, forming sulphate of soda ($\mathrm{Na}^{\cdot}\ \mathrm{S}^{\cdots}$) and allows its former acid to combine with the disengaged iron into carbonate of iron ($\mathrm{Fe}^{\cdot}\ \mathrm{C}^{\cdot\cdot}$).

If you wish to ascertain the presence of soda, you may do so by producing with sulphuric acid the characteristic crystals of sulphate of soda (Glauber's salts = $\mathrm{Na}^{\cdot}\ \mathrm{S}^{\cdots}$), or you employ *antimoniate of potash* ($\mathrm{K}^{\cdot}\ \mathrm{Sb}^{\overset{\cdot\cdot}{\cdots}}$) as a test. When the salt under examination is neutral or alkaline, a white crystalline precipitate of antimoniate of soda ($\mathrm{Na}^{\cdot}\ \mathrm{Sb}^{\overset{\cdot\cdot}{\cdots}}$) is formed, as you see taking place in part of the water prepared for the purpose (which contains most of the ingredients generally found in mineral springs). If acid should predominate, you have to neutralize the salt with some potash before employing the reagent, for else the potash would leave its antimonic acid for the stronger acid of the salt, so that antimonic acid would merely be precipitated without expulsion of the soda; or by the partial loss of potash, the excess of antimonic acid retains the potash and falls down as biantimoniate of potash ($\mathrm{K}^{\cdot}_{2}\ \mathrm{Sb}^{\overset{\cdot\cdot}{\cdots}}$). The solution both of the soda and the reagent must be concentrated in order that a precipitate should be readily formed.

Calcium (Ca) is rarely found as a haloïd salt with fluorine, but more frequently in its oxydised state with carbonic or sulphuric acid as carbonate or sulphate of lime ($Ca^{\cdot}\ C^{\cdot\cdot}$ or $Ca^{\cdot}\ S^{\cdot\cdot\cdot}$). The affinity of lime is inferior to that of the alkalies or of magnesia. Its combinations (with the exception of nitrate of lime and chloride of calcium) are scarcely soluble or insoluble in water—viz., gypsum (sulphate of lime $= Ca^{\cdot}\ S^{\cdot\cdot\cdot}$) is only soluble in 480 parts, and chalk (carbonate of lime $= Ca^{\cdot}\ C^{\cdot\cdot}$) not perceptibly. The solubility is, however, considerably increased by an excess of carbonic acid.

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* You observe that I indicate the atoms of oxygen by round dots; those of sulphur by short dashes at the right upper end of the respective elements.

How then is the presence of lime to be detected? By adding a substance, which exerts a strong affinity for the lime, and forms an insoluble compound with it. This we do by applying *oxalic acid* ($C_2^{\cdot\cdot\cdot}$) or *oxalate* of ammonia, the lime attracts the acid, and precipitates out of the solution as an insoluble salt of *oxalate of lime* ($Ca^{\cdot}\ C_2^{\cdot\cdot\cdot}$).

You see this process in another portion of the water placed on the table.

Magnesium (Mg), mostly combines with acids as oxide ($Mg^{\cdot}$). Its salts are generally more soluble than those of lime; some, however, are scarcely soluble, as basic *phosphate of magnesia,* and fluoride of magnesium. To detect its presence, we employ *basic phosphate of ammonia.* The testing salt does not in this instance give up its acid only to the magnesia, but its base combines with the existing salt, and forms an insoluble double salt, *of phosphate of ammonia-magnesia,* which consequently precipitates. Or we employ phosphate of soda, which also gives a precipitate of phosphate of magnesia, the soda giving up its acid to the magnesia and combining with the acid previously present. The precipitate will be more perfect, if we add *ammonia,* because this will attach itself to the phosphate of magnesia and form the less soluble double salt. The solution ought to be ammoniacal, for excess of acid diminishes the insolubility. Carbonate of potash also precipitates magnesia as carbonate; but part of the magnesia remains in solution as bicarbonate (in an excess of carbonic acid).

Iron (Fe) is either connected (as oxide) with carbonic, crenic, sulphuric, or muriatic acid. It is mostly found as protoxide ($Fe^{\cdot}$) in combination with the weakest acids, and kept in solution by an excess of carbonic acid. It is seldom combined with chlorine (as in Spa). If the protoxide of iron ($Fe^{\cdot}$) be present, *hydrosulphate of ammonia* ($N\ H_4\ S$ and H^1) produces a black precipitate of *sulphuret of iron* (Fe S) from the neutral solution, the ammonia separating the oxydised iron from the acid by its stronger affinity, whilst the abandoned sulphuretted hydrogen gives up its hydrogen to form water with the oxygen of the protoxide, so that the elementary iron may form a compound with sulphur. *Ferrocyanide of potassium* (the yellow prussiate of potash, $K_2\ Fe\ Cy_3 + 3H^{\cdot}$) causes a *whitish* precipitate, which soon becomes blue; the potassium having taken up the place occupied in the solution by iron, and caused the latter to combine with the ferro-cyanogen. By exposing the mixture to the atmosphere, more oxygen will be absorbed by the protoxide of iron, and given up again to the potassium, so that the colour becomes darker, approaching more and more to that of prussian blue. By adding nitric acid, the oxydation of iron proceeds more rapidly, and consequently the formation of the above-mentioned blue precipitate.

Ferrid-cyanide of potassium (red prussiate of potash $= K_3,\ Fe_2,\ Cy_6$) causes a *dark blue* precipitate, resembling prussian blue—viz., ferrid-cyanide of iron ($Fe_2,\ Cy_6$ and Fe_3).

If the solution contains *peroxide* or *sesquioxide* of iron ($Fe_2^{\cdot\cdot\cdot}$), or if the previous protoxide has been transformed into peroxide by the oxydising action of air or of nitric acid, hydrosulphate of ammonia will precipitate the iron as a black sulphuret, by the same process as in the former oxide. The peroxide is deprived of its oxygen by the hydrogen of the hydrothionic acid (H^1), the disunited sulphur then forms the same insoluble compound of sulphuret of iron (Fe S) as with the protoxide.

Prussian blue or *sesqui-ferro-cyanide of iron* ($3Fe\ Cy_3$ and F_4) is precipitated by adding *ferro-cyanide of potassium.*

No precipitate is formed by *ferrid-cyanide of potassium*, which, however, communicates a green colour to the liquid.

Tincture of galls forms black *gallate of iron* (ink).

Iron may also be detected by *succinic acid*, but the solution has to be previously neutralized with ammonia, in case acidity should prevail. A *dark red* insoluble powder of *succinate of iron* precipitates and may be transformed into pure oxide by red heat.

Manganese (Mn) is generally found in the same combinations in which iron is met with. To precipitate it from the solution you make use of its affinity for sulphur, after you have removed the iron or alumina that may have been present.

Hydrosulphate of ammonia causes a gelatinous flesh coloured precipitate of sulphuret of manganese (Mn^{1}). Exposed to the air, the latter is gradually decomposed by absorption of oxygen, into sulphur (S) and hydrated sesquioxide of manganese ($\mathrm{Mn}_2^{\cdots}$ and $\mathrm{H}^{\cdot}$). Carbonate of potash produces a white precipitate of carbonate of manganese, if manganese has been combined with another acid than carbonic.

Aluminium (Al) may either be present as oxide (alumina, $\mathrm{Al}_2^{\cdots}$), or as double sulphate of alumina and potash (*alum*), or with phosphoric or nitric acid. From the latter it is precipitated by caustic ammonia or potash, but potash must not be employed in excess, else it would combine with alumina to form a soluble compound. For alumina resembles silica in this respect of displaying both acid and alkaline properties.

By the characteristic property of receiving a sky-blue colour, if heated before the blowpipe on charcoal, with a solution of *nitrate of cobalt* ($\mathrm{Co}^{\cdot}\ \mathrm{N}_2^{\overset{\cdot\cdot}{\cdots}}$)—even very small quantities of alumina may be detected.

Potassium (K) is occasionally combined with chlorine, more frequently as potash ($\mathrm{K}^{\cdot}$) with sulphuric or nitric acid, always in very small quantities.

To separate it from sodium, we first remove the stronger acids by adding a soluble salt of baryta or lead. We then employ *bichloride of platinum* ($\mathrm{Pt\ Cl_2}$) which produces a crystalline yellow precipitate of chloride of platinum and potassium ($\mathrm{K\ Cl}$ & $\mathrm{Pt\ Cl}$). The double chloride is insoluble in alcohol (chloride of sodium and platinum is soluble in alcohol and water).

Strontium (Sr) is found as strontia ($\mathrm{Sr}^{\cdot}$), with carbonic or sulphuric acid. *Nitrate of lime* ($\mathrm{Ca}^{\cdot}\ \mathrm{N}_2\overset{\cdot\cdot}{\cdots}$), dissolved in anhydrous alcohol, will cause a precipitate of nitrate of strontia. This is dissolved in water. *Oxalate of ammonia* ($\mathrm{N\ H_4\ O\ C_2}^{\cdots}$) will then precipitate *oxalate of strontia* out of a concentrated solution as a white substance. If you heat the latter to redness, the oxalic acid ($\mathrm{C_2}^{\cdots}$) will be transformed into carbonic ($\mathrm{C}^{\cdot\cdot}$) by the absorption of another atom of oxygen. Sulphate of strontia is precipitated by sulphuric acid, or by sulphate of lime (after some time). It is soluble in hydrochloric acid.

The flame of alcohol, in which a salt of strontia is dissolved, becomes of a carmine tint.

Lithion (Li) is met with in very minute quantities, combined with chlorine, or as Lithia ($\mathrm{Li}^{\cdot}$) with sulphuric or carbonic acid. Phosphoric acid ($\mathrm{P}_2\overset{\cdot\cdot}{\cdots}$) produces a white powder, which slowly sinks to the bottom. By *phosphate of soda and ammonia* you will likewise obtain a white precipitate. Or you may saturate the lithia and other bases with sulphuric acid; then deprive them of the excess of acid, by heating. You separate lithia from sulphate of potash or soda by alcohol, which leaves the two latter undissolved.

Barium (Ba), extremely rare. It was found as carbonate ($\mathrm{Ba}^{\cdot}\ \mathrm{C_2}^{\cdot\cdot}$) in the evaporation of Ems and Selters-water. The quantity is too minute to decompose the sulphates. Baryta is readily precipitated by sulphuric acid, sulphate of soda, or sulphate of lime, as a white mass, insoluble in hydrochloric or nitric acids. *Oxalate of ammonia* causes crystals of oxalate of baryta; but the solution requires to be stronger than if you test for lime. *Hydro-silico-fluoric* acid combines also with baryta into an insoluble salt.

Ammonium ($\mathrm{N\ H_4}$) is extremely rare. The combinations in which ammonia ($\mathrm{N\ H_3}$) exists as base are easily recognised.

If you heat their solutions with potash, soda, or hydrated lime, the ammonia escapes and allows the testing bases to unite with the remaining acid.

If exposed to heat on platinum foil no fixed residue is left of the ammoniacal salts, the acid and alkali becoming volatilised (with the exception of such acids as are fixed at a red heat, as boracic or phosphoric).

If you distil an ammoniacal solution with bichloride of platinum ($Pt\ Cl_2$), you obtain a *yellow* precipitate of *chloride of plantinum and ammonium* ($Pt\ Cl_2$ and $N\ H_4\ Cl$). This resembles the double chloride of potassium and platinum. To ascertain, therefore, whether ammonia or potash has been obtained, you have to ignite the compound, and treat the residue with water. *Nitrate of silver* will then help you to distinguish the alkali. If *ammonia* was the base which joined the platinum, no re-action will ensue, for the chlorine and ammonium have escaped by the heat and left the pure spongy platinum. If, however, *potash* originated the precipitate, you will obtain chloride of silver by the test. For instead of the pure metal, you have chloride of potassium still attached to it, unvolatilized by the action of heat.

Now, Gentlemen, let us consider the acids, and electro-negative elements you have to seek in mineral springs.

Carbonic acid ($\ddot{C}$, the most frequent) exists both in a free state, and combined with bases. There is some contained in the prepared water before you. We had to put pounded marble ($\dot{Ca}\ \ddot{C}$) into a glass vessel. By adding equal quantities of hydrochloric acid and water, the carbonic acid yielded its position to the stronger acid, and passed off as a gaseous body into this liquid, where it helped to dissolve the carbonates of lime, of magnesia, and of iron, with which the water had been charged.

You are aware that carbonic acid is an irrespirable gas, much heavier than common air, its specific gravity being 1·527, so that 100 cubic inches weigh about $47\frac{1}{3}$ grains. It not only prevents combustion by the absence of oxygen gas, but by a property of its own; for the light becomes extinguished if you expose it to a gaseous mixture of four parts of atmosphere, with one of carbonic acid. This power has been made use of lately in a very ingenious contrivance for extinguishing flames by means of chemical action.

Inspiration of pure carbonic acid is prevented by a spasmodic closure of the glottis. But if sufficiently diluted with air, it may enter the lungs, and exhibit deleterious effects, as it has occasionally happened with persons who slept in a closed room with a burning fire.

And still this very same gas exerts such beneficial influences, if passing into another organic cavity, the digestive canal. Its presence causes our beverages to be palatable, whilst its absence renders them insipid.

You will probably have seen carbonic acid, compressed into a semi-solid congealed state, producing a sensation of such intense cold, that it could not be distinguished from that of burning. This process induces the probability, that at very great depths the acid may exist in a liquid or solid condition, and assume the gaseous form when brought into contact with the atmosphere, relieved of the compressing forces.

You will remember that 100 volumes of water absorb about 106 of carbonic acid at the common atmospheric pressure, whilst in proportion to increased weight a greater amount may be absorbed. But as soon as that inordinary contracting power ceases, the elastic body will expand, and the supernumerary volumes will be driven off, under the appearance of *sparkling* or *effervescence*, till the equilibrium will be restored between the gaseous contents of the liquid and the circumambient air. That a very small quantity of carbonic acid is always admixed with the atmosphere is well known, forming another instance of the great utility, or even necessity, of an apparently injurious substance, fixed to its appropriate measure by the working apparatus of nature.

To discover the presence of free carbonic acid in a liquid, we have merely to add *lime water* ($Ca^{\cdot}$ and $H^{\cdot}$); you see directly a milkiness arise, which becomes a white precipitate of *carbonate of lime* ($Ca^{\cdot}\ C^{\cdot\cdot}$). By adding some more water, the former clearness and transparency is reproduced, because the additional carbonic acid redissolves the precipitate.

Tincture of litmus becomes red, if added to the carbonated water. No reaction will be produced by litmus, after the water has been boiled, for the carbonic acid has been driven off by the expanding power of the gradually extending watery vapours, which will fill up all interstitial vacancies, and expel heterogeneous gases, till their own bulk overcomes the diminished atmospheric pressure, when entering into a gaseous condition.

The carbonic acid thus escaping may be conducted into a solution of *sub-acetate of lead* ($_3Pb^{\cdot}$ & $C_4\ H_3\ O_3$), when carbonate of lead ($Pb^{\cdot}\ C^{\cdot\cdot}$) will be precipitated.

Chloride of barium (Ba Cl), or *chloride of calcium* (Ca Cl), mixed with caustic *ammonia*, will also cause precipitates of carbonate of baryta, or of lime, the ammonia forming hydrochlorate of ammonia with the chlorine.

If carbonic acid be combined with metals or earths, it may be driven off by a strong heat. From the alkalies it may be separated by the superior affinity of a stronger acid.

Sulphuretted hydrogen ($H\ S = H^1$) or *hydrothionic acid* (from ὑδωρ, water, and θειον, sulphur) is likewise a gaseous acid often evolved out of mineral springs.

You recognise its presence in the solution before you by the characteristic *smell of rotten eggs*. I may repeat here, by the bye, that one cold sulphurous spring—viz., *Weilbach*, near Mainz, exhibits the curious property of smelling and tasting more like fresh than rotten eggs, though it possesses more than two cubic inches of sulphuretted hydrogen in sixteen ounces. The acid was just prepared by placing pieces of *sulphuret* of iron (Fe S) into a bottle, and pouring dilute sulphuric acid (one part to eight of water) upon them. The gas was then passed by a bent tube through water, to become freed from any mechanical admixture, and thence conducted into this bottle of distilled water. I need not explain to you, that the tendency of the sulphuric acid to combine with iron, caused that metal to disunite the elements of water, and to absorb its oxygen; *sulphate of iron* being thus formed, the bereft sulphur enters into combination with the equally abandoned hydrogen to form the sulphuretted hydrogen gas.

By a great pressure it may be transformed into a limpid liquid. It bears in many other respects great analogy to carbonic acid. Its effect is deleterious, if only present at the proportion of one eight-hundredth part. In one experiment, the death of a horse was produced by an atmosphere, to which a one hundred and fiftieth part of the gas was admixed. Its specific gravity is 1·180, and one hundred cubic inches weigh 36 3-5ths grains. It reddens litmus paper, and forms salts with alkalies. Hydrochloric and sulphuric acids decompose the hydrosulphates, as they do the carbonates.

If you merely expose the solution to air, its hydrogen will gradually be absorbed by the atmospheric oxygen for the formation of water, and the sulphur will become deposited.

It is equally decomposed by the *halogens* chlorine, iodine and fluorine, which absorb its hydrogen, and leave the sulphur isolated. From this property chlorine is stamped as such a powerful purificator of volatile animal effluvia. The strong affinity of metals for sulphur causes likewise its ready decomposition, for the formation of sulphurets—and water.

Though water possesses the property of absorbing a considerably greater quantity of sulphuretted hydrogen than of carbonic acid, still a comparatively small proportion is evolved, even in the most powerful sulphurous springs—viz., from a fraction of a cubic inch to two or three cubic inches.

To detect its presence, we have merely to moisten a piece of white paper with a solution of *acetate of lead*. The immediate production of blackness is due to the abovementioned affinity of lead for sulphur, which leads to mutual decomposition. The oxide of lead gives up its oxygen to the hydrogen of the hydrothionic acid for the formation of water—and sulphuret of lead. A solution of the acetate will, on the same account, cause a *black* precipitate of *sulphuret of lead.*

Chlorine (Cl) gas is never present in its elementary state. Even if mixed with air, it would produce great irritation of the faucès and a suffocating sensation. You are aware that its specific gravity is greater than that of the above-mentioned gases—viz., 2·47, so that 100 cubic inches weigh $76\frac{1}{2}$ grains. About four atmospheres are sufficient to compress it into a yellowish liquid. You know that under the influence of light the chlorine decomposes water, and unites with its hydrogen. You are further acquainted with its power of bleaching, and removing animal and vegetable colours, under evolution of muriatic acid and oxygen; but we have chiefly to look for chlorine in combination with sodium (as *culinary salt*) or other bases. Its presence is readily detected, by the flocculent precipitate which you see formed, as soon as we add a solution of *nitrate of silver* ($\mathrm{Ag}^{\cdot}\ \mathrm{N}_2\overset{\cdot\cdot}{\cdots}$) to this clear liquid.

The affinity of *chlorine for silver* causes the decomposition. The oxygen, combined with the silver, oxydises the basic element to which chlorine had been attached, so that a new nitrate is formed in the solution, whilst the chloride of silver falls down. Nitric acid does not dissolve the precipitate, but ammonia restores the liquid to its former transparency, because it forms hydrochlorate of ammonia with the chlorine, and allows the silver to be redissolved in the nitric acid.

Iodine (I) is frequently met with in mineral springs, but invariably in a combined state. Its elementary characters are too well known to allow of their being further alluded to. Though it appears as a solid, bluish, shining body, more than three times heavier than water, it exhibits great analogy to chlorine. Its vapour exhibits the remarkable density of 8·7, so that 100 cubic inches weigh $271\frac{1}{3}$ grains.

Water does not dissolve it easily (only the seven thousandth part), but it is perfectly soluble in alcohol and ether.

Its quantity in the springs is too small to be acted upon by reagents without employing a very large quantity of water. I avail myself, therefore, of a solution of *iodide of potassium* for our present purpose. You well know the great affinity of iodine for *starch*, which is made use of for its detection. But before applying the test, we separate the iodine from the potassium by adding nitric acid, which both oxydises the latter and then forms a soluble nitrate of potash with it. If we now pour a solution of starch into the liquid, the *dark purple* precipitate will at once inform you of the presence of iodine.

The *straw-coloured* precipitate formed by nitrate of silver is less soluble in ammonia than the chloride of silver, and nearly insoluble in nitric acid.

Soluble *salts of palladium* (for instance, protochloride) precipitate the iodine as a black insoluble powder of *iodide of palladium.*

Iodine is only found in saline waters.

Bromine is rarer still, and generally found in combinations analogous to those of iodine. The element is well known to you as a blackish red liquid of a peculiarly marked odour. Its specific gravity is 3·, that of its vapour 5·39. Its best solvent is *æther,* though water dissolves it likewise. It also exercises an injurious influence on animal life.

To recognise it you may heat bromide with nitric or hydrochloric acid, when bromine will be separated. Nitrate of silver produces a yellow precipitate. Though its quantity is very small, its therapeutic value is considerable; the more so, as it is often contained in greater abundance in the mother-water of salt springs, than in the sources themselves (as is the case in Kreuznach).

Fluorine (Fl) is extremely rare, and only found in combination with silica. It is recognised by treating its compounds with sulphuric acid. Fumes of hydro-silico-fluoric acid are formed, with their characteristic property of corroding glass.

Sulphuric acid ($\dot{\dot{\dot{S}}}$) is frequently found in combination with bases, but never in an isolated condition. Its separation by *chloride of barium,* or nitrate of baryta, is too familiar to you to require further explanation. I add hydrochloric acid, but the precipitate remains insoluble. Sulphate of soda, of magnesia, or of lime, is ordinarily the combination in which you meet with the sulphuric acid.

Silicic acid or silica ($\mathrm{S^{\cdot}i^{\cdot}}$) exists in almost every spring. You are aware of its curious property, to have an *isomeric* soluble modification (if a certain proportion of water is attached to it), whilst it is usually an insoluble powder, attacked by no other acid but the *hydrofluoric*. Quartz-rock, sandstone, flint, almost exclusively consist of silica. By exposing transparent rock-crystal to a red heat, and then immersing it in water and pounding it, the infusible and insoluble white powder of silica may be obtained, only fusing before the oxy-hydrogen blow-pipe.

But if you prepare the same acid out of a concentrated warmed solution (for instance, of silicate of potash, $\mathrm{K^{\cdot}\ S^{\cdot\cdot\cdot}}$) by hydrochloric acid, the massy precipitate obtained is soluble in potash, whilst a part of the silica remains dissolved in the acid solution. It seems, then, that if, at the formation of silicic acid, water has been present, the soluble modification results, whilst you have only to expel the water from the above solution and precipitate by evaporation, to obtain the insoluble modification, unchanged by hydrochloric acid, and scarcely soluble in cold alkaline solutions.

From its insolubility, it does not redden litmus. If you heat *one part of silica with three of carbonate of potash* or soda to redness, the carbonic acid escapes, and a deliquescent vitreous mass results, perfectly *soluble* in water, with an alkaline reaction, and a tendency to attract carbonic acid from the atmosphere. If you employ, however, *three parts of silica to one of the alkali*, you obtain the insoluble transparent *glass*.

Whether silica presents itself in the mineral waters in its free state, or combined with alkalies, is not ascertained. The above-described properties sufficiently mark the mode of its detection.

Nitric acid ($\mathrm{N_2}^{\overset{\cdot\cdot}{\cdot\cdot\cdot}}$) is very rare, and when present, only of a small amount, in combination with alkalies. It is recognised by separating the nitric acid through the agency of sulphuric. If we warm it then with some *sulphate of indigo,* the blue colour vanishes. Or if you put copper filings into a heated solution of a nitrate mixed with sulphuric acid, the copper decomposes the nitric acid, absorbing part of its oxygen, and setting free the characteristic *orange-coloured* fumes of nitrous acid and nitric oxide.

Phosphoric acid ($\mathrm{P}_2\overset{\cdot\cdot}{\cdot\cdot\cdot}$), in the tribasic modification ($\mathrm{H}^{\cdot}$ and $\mathrm{P}_2\overset{\cdot\cdot}{\cdot\cdot\cdot}$), is occasionally found in combination with alumina and lime.

To detect it, you have in many instances merely to remove the carbonic acid by lime water, several phosphates being dissolved in an excess of carbonic acid only. Nitrate of silver produces a yellow precipitate (tribasic phosphate of silver = $3\ \mathrm{Ag}^{\cdot}$ and $\mathrm{P}_2\overset{\cdot\cdot}{\cdot\cdot\cdot}$), soluble both in nitric acid and ammonia. A white precipitate of *phosphate of lead* ($3\ \mathrm{Pb}^{\cdot}$ and $\mathrm{P}_2\overset{\cdot\cdot}{\cdot\cdot\cdot}$) is obtained by testing with acetate of lead ($\mathrm{Pb}^{\cdot}$ C_4, H_3, O_3, and $_3$Aq). Heated before the blow-pipe, this precipitate becomes a semi-transparent *bead,* and crystallises in cooling. This lead salt is *not* reduced to its metallic condition by being heated in the inner flame of the blow-pipe.

Crenic acid (from κρήνη, fountain) must be considered as a product of lixiviated humus. It imparts a yellowish colour to the water during evaporation. It is separated by treating the carbonates with acetic acid. If you then add *acetate of copper,* the crenic acid will expel the acetic, and precipitate, as *crenate of copper,* in greenish white flakes, in the proportion of 93·19 of oxide of copper, and 6·87 of crenic acid.

Acetic acid (C_4, H_3, O_3) occurs in some springs, in the neighbourhood of coal or carbonaceous salt mines. It contains 47 parts of carbon in 100, whilst its oxygen and hydrogen are in an exact proportion for forming water. It results from acetous fermentation, as well as from destructive distillation of vegetable substances. It is separated by distilling with sulphuric acid. You remove the latter by baryta, neutralize with carbonate of potash, evaporate to dryness, and then extract with alcohol.

The affinity of acetic acid is superior to that of silicic and carbonic, but inferior to crenic acid.

The properties of *oxygen* (O) and *nitrogen* (N) are too well known to require being mentioned. Their exact quantity is determined by the *eudiometric* apparatus. After having removed the carbonic acid by passing it into a mixture of chloride of barium and ammonia, you mix with the gas under examination a sufficient quantity of hydrogen for binding the oxygen present. If you then pass an electric spark through the mixture, one volume of oxygen will disappear with two of hydrogen. Thus a third part of the diminished gaseous contents gives the quantity of oxygen. The remaining gas is nitrogen, and its amount is easily calculated by subtracting the loss sustained. The quantity of oxygen being generally small in the mineral waters, it is advisable to add a weighted quantity of this gas.

In the mud-baths *carburetted hydrogen* ($C\,H_4$) is developed by the presence of organic substances. It is decomposed by the electric spark into carbon and hydrogen. If you mix it with double its quantity of oxygen, you obtain carbonic acid (C· ·) and water (H·).

Suppose, then, we wish to ascertain the constituents of a mineral water—for instance, *Heppingen;* we ought first to acquaint ourselves with the *quality* of the dissolved substances. For this purpose we take thirteen wineglasses and fill ten with fresh mineral water, and three with another portion of the same water, which has been boiled for about half an hour and filtered.

Tincture of litmus produces a red colour in the *first glass,* consequently there is free acid present. The nature of the acid we immediately determine by pouring the tincture into the boiled water. No reaction ensues. The acid must thus be a volatile one—viz., carbonic (17 cubic inches of the gas are contained in 16 ounces).

Lime water forms an immediate cloudiness, and ultimate precipitate in the *second glass.* We add some more mineral water, the deposit vanishes to give way to the former transparency, because the precipitated carbonate of lime re-dissolves in an excess of carbonic acid. This affords us a second proof of the nature of the free acid.

Tincture of curcuma shows no reaction in the fresh water of the *third glass,* but becomes distinctly brown in the boiled portion. This shows some carbonate of alkalies to be present.

Chloride of barium poured into the *fourth glass* causes a deposit of *sulphate of baryta.* We add hydrochloric acid, the precipitate remains undissolved (two grains of sulphate of soda are contained in 16 ounces).

Nitrate of silver produces in the *fifth glass* an immediate precipitate, not dissolved by the nitric acid we add; but ammonia restores the former clearness. From the insoluble *chloride of silver* we are informed of the presence of chlorine (three grains of chloride of sodium in 16 ounces). If the precipitate should have a wine-red colour, we should suspect the presence of organic matter.

Oxalate of ammonia, or *bioxalate of potash,* precipitates in the *sixth glass* oxalate of lime. This of course shows the presence of lime. The same test shows no reaction in the boiled portion; consequently, the lime was merely dissolved in an excess of carbonic acid, and separated by the liberation of its solvent. About $1\frac{1}{4}$ grains of carbonate of lime are contained in the water.

Basic phosphate of ammonia combines in the *seventh glass* with the magnesia to form the insoluble ammonia-phosphate of magnesia; $2\frac{1}{4}$ grains of carbonate of magnesia are contained in sixteen ounces.

Caustic potash expels, through its stronger affinity, in the *eighth glass,* the metallic oxides and earths previously held in solution with the acid. The turbidity we perceive shows the presence of such oxides.

Neutral carbonate of potash attracts *in the ninth glass,* containing *boiled* water, the acids of those metallic oxides and earths which are not combined with carbonic acid, and causes them to precipitate as carbonates.

Ferrocyanide of potassium would produce *in the tenth glass* a blue precipitate of iron, if iron were present, but you do not see that reaction, the small quantity of iron, previously extant, having been liberated by the loss of carbonic acid.

In *the eleventh glass* (containing *boiled* water), antimoniate of potash shows by the precipitate the presence of soda.

Tincture of galls poured into *the twelfth glass* will, after some time, produce a purple and afterwards a black colour, if oxide of iron be present. The addition of lime-water, which binds the solving carbonic acid, will make the reaction stronger.

If, in the *thirteenth glass,* which contains *boiled* water, tincture of galls produces no purple colour, the iron was a carbonate, and has been separated by boiling. If the colour is greenish-brown, the presence of an alkali is shown.

This preliminary examination will throw in many instances a sufficient light on the contents of the springs; and the tests employed in the same order at each special spa will give a comparative view of the respective quantities by the mere readiness or slowness of reaction.

However, to make an exact quantitative analysis of a given mineral water, we have first to evaporate a determined portion to dryness, and to weigh the residuum. The foreign gases escaping during ebullition are to be collected—the *carbonic acid* by passing into a graduated jar filled with mercury, and the *sulphuretted hydrogen* by transmitting it through a solution of acetate of lead. The sulphuret of lead produced will give the weight of the latter. The residuum is divided into two classes of bodies by distilled water, which removes all the soluble particles, leaving the insoluble in the filter. We first examine the salts dissolved in the water. For this purpose we have again to evaporate, to dry, and to weigh them. We divide, then, the dried salts into several portions. We examine *one* for *chlorine,* by acidifying with nitric acid, and then adding nitrate of silver as long as a precipitate falls down (chloride of silver). We then boil the mixture a few minutes (in order that the precipitate may not pass partially through the filter), then filter and dry the precipitate. It is then ignited and weighed. The quantity of *chlorine* present is then determined by the proportion which the atomic weight of chloride of silver bears to that of chlorine—viz., 144 to 36; thus its amount is one-fourth of the precipitate.

Another portion is examined for *sulphuric acid.* We acidify with muriatic acid, and then precipitate sulphate of baryta with chloride of barium; having dried and weighed the precipitate, we can easily calculate the amount of sulphuric acid, by knowing that 100 parts of sulphate of baryta contain 34·37 of *sulphuric acid,* or rather more *than one-third.*

Carbonic acid is also determined by chloride of barium, without addition of acid. Carbonate of baryta precipitates besides the sulphate. Deduct from the sum the known quantity of sulphate of baryta, found before, and the rest is *carbonate of baryta,* possessing 22·41 parts of carbonic acid in 100; thus rather *more than one-fifth.* Or carbonic acid may be estimated in the following way: we fill a piece of tube with fragments of chloride of calcium, and close it at each end with a loose plug of tow; we then connect it by a bent quill tube with a flask. A strong test tube is nearly filled with hydrochloric acid, and placed in an *inclined* position into the flask, so as not to come in contact with the contents of the flask, consisting of the liquid carbonate under examination. We now incline the flask so as to allow the acid of the tube to fall gradually on the carbonate. Carbonic acid is evolved and deprived of any adherent moisture by passing over the chloride of calcium placed in the external tube. After the carbonic acid has escaped through the small hole of that tube, the flask is gently warmed, and air is allowed to pass through, when cool again. If the whole is weighed now, the deficiency, as compared with the weight before the disengagement of the gas, will indicate the quantity of carbonic acid.

We have now to examine for the *bases.* If earths or metallic oxides are contained in the water, they are better precipitated with carbonate of soda, and treated with the insoluble part.

One portion is now tested for *lithia.* It is precipitated by phosphate of soda. We evaporate the water, and weigh the precipitate; 100 parts of the insoluble residue (phosphate of lithia) possess 14·39 of lithia; that is, *one-seventh.*

Another portion is tested for *potash* by an alcoholic solution of bichloride of platinum. With 100 parts of the precipitate (bichloride of platinum and potassium) 19·33 of potash correspond, or rather less than *one-fifth.*

The quantities found till now must be so calculated, that acids and bases correspond in a manner to have a sufficient amount of acid as a rest, for the neutralization of *soda,* the quantity of which is determined by deducting from the whole sum of bases those obtained; or the soda may be determined by evaporating the solution, and *transforming* the soda or sodium into sulphate of soda, by means of sulphuric acid. The residue is dried, ignited, and weighed. The exact proportions of the simple substances are easily found by comparison with the known atonic weights of the compounds. Thus, in the present instance, we know the proportion of sulphate of soda to sodium is as 72 to 24. Thus in the sulphate of soda obtained, we have to set down the third part as sodium.

The *insoluble residue* is now dried and weighed, and then treated with muriatic acid, and boiled till all carbonic acid is removed.

The presence of carbonates of alkalies in the soluble portion excludes the possibility of other acids existing in the insoluble part but carbonic, for they would have been attracted by the alkalies, with the exception of a small quantity of phosphates or fluorides. What, then, have we to seek in the acid solution?—Lime, magnesia, strontia, lithia, phosphate of alumina, oxide of iron, oxide of manganese, fluoride of calcium, and silica.

We evaporate and test for *fluorine* by *ammonia,* which combines with the solving muriatic acid, and causes fluoride of calcium to precipitate; 100 parts contain 47·73 of fluorine, thus rather less than one-half.

We apply some more hydrochloric acid and heat; all other substances will be dissolved and *silica* left. To ascertain the amount *of iron,* we neutralize the acid solution with ammonia, and add a few drops of hydrosulphate of ammonia.

The iron will precipitate as a black sulphide. This is filtered and washed, then digested with hydrochloric acid, which decomposes the sulphide. We expel the hydrosulphuric acid formed by boiling, we then heat with nitric acid in order to peroxidize the iron. By adding now ammonia in excess, hydrated *peroxide of iron* precipitates. The precipitate is dried, ignited, and weighed.

To estimate the quantity of *lime,* the solution is boiled with hydrochloric acid, for the purpose of expelling the hydrosulphuric acid possibly left from the former test. We then filter and neutralize the solution with ammonia. If we add now *oxalate of ammonia,* the lime contained in the solution will precipitate with oxalic acid, while magnesia remains dissolved. By filtering and igniting the precipitated oxalate of lime, it is transformed into carbonate of lime. When cool, it is mixed with a solution of *carbonate of ammonia* (as a portion of carbonic acid had been expelled by heat), and exposed again to gentle heat so as to give off the excess of carbonate of ammonia, and be entirely transformed into carbonate of lime. The weight of this will inform us of the exact quantity of lime present, by the proportion which the atomic weight of carbonate of lime bears to that of lime—viz., 50 to 28.

To ascertain the quantity of *magnesia,* we evaporate the filtered solution, and treat it with phosphate of soda and caustic ammonia. After a few hours, the magnesia is found precipitated as a double *phosphate of ammonia* and *magnesia.* We add then a few drops more of phosphate of soda, to see whether no fresh precipitate is formed. We then filter the mixture, ignite the precipitate, and dry. By the heat the water and ammonia have been driven off, and thus the double phosphate has been decomposed into phosphate of magnesia. The weight of this determines the amount of magnesia. The atomic weight of phosphate of magnesia being 112, and that of magnesia 20, we have merely to calculate the proportion of 112 to 40 (as two atoms of magnesia are combined with one of phosphoric acid) to ascertain the exact amount of magnesia present.

For the determination of the more minute metallic or earthy oxides, the adjoining table, by Liebig, may be of advantage.

After silica has been separated by hydrochloric acid and heat, the solution is treated with ammonia.

The *Liquid* contains lime, magnesia (strontia, lithia), manganese. Add hydrosulphate of ammonia.

Liquid is oversaturated with free acid and boiled, magnesia is separated from lime by oxalate of ammonia. — *Precipitate* is *sulphuret of manganese.*

Liquid contains magnesia, lithia. Evaporate, heat, dissolve in water. — *Precipitate* consists of oxalate of lime and strontia. Transform the precipitates into dry neutral nitrates. Treat with alcohol.

Liquid contains *nitrate of lime.* — *Residue*, nitrate of strontia.

Liquid—Residue after ignition. Add sulphuret of barium; filter. Add sulphuric acid; filter, evaporate, ignite.

Residue and the *precipitate* obtained by sulphuret of barium contain all the magnesia. Separate from baryta by sulphuric acid.

Residue is sulphate of lithia.

The *Precipitate* contains oxide of iron, phosphate of alumina, traces of magnesia and manganese. Dissolve in hydrochloric acid. Oversaturate and boil with potash.

Liquid contains alumina and phosphoric acid. Oversaturate with acid, subsequently with ammonia. — *Precipitate* contains oxide of iron (traces of manganese). Phosphoric acid, magnesia.

Precipitate is *alumina*, or *phosphate of alumina.*

Dissolve in hydrochlorate of ammonia. Add hydrosulphate of ammonia.

In the *liquid* are traces of phosphoric acid, and magnesia. — *Precipitate* is *sulphuret of iron*, with traces of manganese.

Having found the exact quantities of the acids and bases, they are somewhat arbitrarily connected in the analysis according to the greater or smaller affinity of the different component parts, and according to the degree of solubility of the respective salts. For as you have seen, the analysis discovers not sulphate of soda, nor chloride of calcium, nor carbonate of iron, but so much sulphuric acid, so much sodium, &c. The above very short outline will afford you some assistance in comparing the ingredients of a spring obtained by yourselves with any given analysis, though of course many modifications are made use of in the different processes. In conclusion, I subjoin the following tables to facilitate the *comparison* of analogous springs as regards their chemical constituents—

The Four chief Akratic (chemically indifferent) Spas.

	Gastein.	Pfeffers.	Teplitz.	Wildbad.
Temperature	120° F. = 39° R.	99½° F. = 30° R.	121° F. = 39½° R.	90° to 98° F. = 25° to 28° R.
Situation	Tyrol.	Switzerland.	Bohemia.	Wurtemberg.
Carbonic acid	—	4·15 cu. in.	0·39	Gas in 100 parts evolved 2·00.
Sulphuretted hydrogen	—	—	—	—
Nitrogen	—	3·7	0·49	91·56
Oxygen..	—	1·3	—	6·54
Sum total of solid constituents ..	2½ gr.	2½	4·84	3·61
Sulphate of soda, *ch*...	1·51	0·62	—	0·40
" potash ..	—	—	—	0·02
" lime.. ..	—	0·37	—	—
Chloride of sodium ..	0·36	0·21	0·43	1·82 *ch.*
" magnesium	—	0·16	—	—
Carbon. of soda.. ..	0·23	—	2·68 *ch.*	0·53
" magnesia	0·03	0·87 *ch.*	0.05	0·07
" lime.. ..	0·36	0·32	0·32	0·34
" iron.. ..	0·05	0·006	0·03	0·02
" manganese	—	—	0·08	0·02
Silica	0·24	0·14	0·31	0·39
Glairine	—	—	—	—

N.B.—*Ch.* is placed near that substance which constitutes the chief ingredient.

Warm and Hot Saline Springs (*Halothermæ*).

	Aix-la-Chapelle, (belonging also to the sulph. wat.)	Baden-Baden.	Borcette (Burtscheid).	Nauheim (Soolensprudel).	Oeynhausen.	Wiesbaden.
Situation	Rhenish Prussia.	Baden.	Rhenish Prussia, adjoining to Aix-la-Chapelle.	Electoral Hesse.	Westphalia.	Nassau.
Specific gravity	1·004	—	1·003	1·023	1·017	1·006
Temperature	130° F. = 46° R.	153½° F. = 54° R.	136° F. (one spring) 46° R. = 171° F.	92¾° F. = 27° R.	91½° F. = 26½° R.	158° F. = 57° R.
Carbonic acid	8 cubic in.	0·5 cubic in.	7·71 cubic in.	13¾ cubic in.	—	6·87 cubic in.
Sulph. hydrogen.. ..	0·13 cubic in.	—	0·05	—	—	—
Nitrogen	18·53	—	18·86	—	—	0·08
Oxygen..	—	—	—	—	—	—
Sum of constituents ..	31·94 grs.	23·15 grs.	32·86 grs.	245 grs.	313 grs.	57·59 grs.
Sulphate of soda.. ..	2·12	—	2·56	—	—	0·70
„ „ potash ..	—	—	—	—	0·36	—
„ „ magnesia	—	—	—	—	19·99	—
„ „ lime . ..	—	3·00	—	0·53	22·99	0·42
Chloride of sodium ..	20·71 *ch.*	16·00 *ch.*	21·62 *ch.*	207·78	256 39	44·22 *ch.*
„ „ magnesium	—	0·25	—	2·82	8·28	0·79
„ „ calcium ..	—	1·75	—	17·34	—	5·48
Carbonate of soda ..	6·61	—	6·59	—	—	—
„ „ magnesia	0·15	—	0·11	—	3·85	0·70
„ „ lime ..	0·23	1·66	0·24	16·99	6·67	1·65
„ „ iron ..	—	0·10	—	0·10 (No. I. 0·75)	0·51	—
„ „ mangan.	—	—	—	0·02	0·01	—
Silica	0·53	0·33	0·55	0·01	—	—
Extractive substances	—	0·05	—	Tr. of brom. chrenic ac. &c.	—	1·76

Cold Saline Springs (Halokrenæ) which do not possess a prominent amount of Iodine or Bromine.

	Homburg. (Kurbr.)	Ischl. (Soolquelle.)	Kissingen. (Rakoczy.)	Soden. (Milchbr.)
Situation	Hesse-Homburg.	Austria.	Bavaria.	Nassau.
Specific gravity	—	—	—	1·003
Temperature	53° F. = 9½° R.	—	52° F. = 9° R.	72° F. = 18° R.
Carbonic acid	48·78 cu. in.	—	26·85	13·62
Sum total of solid ingredients	108·8 grs.	238·5 grs.	85·74 grs.	22·66 grs.
Sulphate of soda	0·38	4·85	2·00	—
„ magnesia	—	1·82	—	—
„ lime	—	1·02	2·50	0·19
Chloride of sodium ..	79·15 *ch.*	223·0 *ch.*	62·05 *ch.*	17·68 *ch.*
„ magnesium	7·76	7·10	6·85	—
„ calcium ..	7·75	0·78	—	—
Carbonate of soda ..	—	—	0·82	—
„ magnesia	2·01	—	2·50	1·37
„ lime ..	10·98	—	3·55	2·73
„ iron ..	0·46	—	0·68	0·16
Silica	—	—	2·25	0·16
Extractive substance ..	—	—	0.15	—

Cold Saline Springs, distinguished by a prominent amount of Iodine or Bromine (Iodepegæ).

	Adelheidsquelle of Heilbrunn.	Hall, near Steyer.	Kreuznach, Elisenquelle.	Salzhausen.
Situation	Bavaria.	Austria.	Prussia.	Hessen.
Specific gravity ..	—	1·108	—	1·008
Temperature	—	58° F.	—	58° F. = 11½° R.
Sum total of solid ingredients ..	43·22 grs.	158·6 grs.	90·68 grs.	98·39 grs.
Sulphate of magnes.	—	0·68	—	—
„ lime ..	—	—	—	11·17
Chloride of sodium	36·90	84.58	72·92	73·45
„ potass.	—	—	0·97	—
„ magnes.	—	—	0·25	8·78
„ calcium	—	3·35	13·27	2·57
Carbon. of soda ..	4·25	Chlor. of alumin. 3·9	—	—
„ magnes.	0·23	Chlor. of lithia, 6·8	1·35	—
„ lime ..	0·50	—	—	—
Silica	0·12	—	—	—
Iodide of sodium ..	0·91 *ch.*	5·53 *ch.*	0·03	0·59 *ch.*
„ potassium	—	—	0·003	—
Bromide of sodium	0·30	—	0·30 *ch.*	—
„ magnes.	—	—	0·2	—
Carburetted hydro.	4 cub. in. in 100	The water is commonly called *Kropfwasser* (goitre water.)	—	—

Spas with predominance of Carbonate of Soda (*Natropegæ*).

	Bilin.	Ems, Kessel-brunnen.	Fachingen.	Obersalz-brunn.	Schlangenbad, Schacht-brunn.
Situation	Bohemia.	Nassau.	Nassau.	Prussia.	Nassau.
Temperature ..	52° F. = 9° R.	118° F. = 38° R. Kränchen 84° F. = 26° R.	50° F. = 8° R.	46° F. = 6° R.	88° F. = 25° R.
Carbonic acid ..	33½ cu. in.	12·45cu.in. Kränchen 17·40	19·68 cu. in.	25·63cu.in.	1·75 cu. in.
Nitrogen	—	—	—	—	0·20
Sum total of solid ingredients	38 grs.	21·35 grs.	25·33 grs.	17·19 grs.	6 grs.
Sulphate of soda	6·17	—	0·16	2·94	—
„ potash	1·73	—	—	—	—
Chloride of sodium	2·88	7·63	4·31	1·16	1
„ magnes.	—	—	—	—	0·06
„ lime	—	—	—	—	0·18
Carbon. of soda	22·73 *ch.*	10·75 *ch.*	16·43 *ch.*	8·15 *ch.*	3 *ch.*
„ magnes.	1·19	0·78	1·73	1·88	0·75
„ lime	3·06	1·14	2·49	2·33	1
„ iron	—	0·02 Kränchen 0·01	0·08	0·03	—
„ mangan.	—	—	—	—	—
Silica	0·35	0·41	0·08	0·33	—

Acidulous Springs (*Anthrakokrenæ*).

	Birres-bronn.	Fachingen.	Geilnau.	Heppin-gen.	Kissingen, Säuerling or Maxbr.	Selters.
Situation	Prussia, district of Trier.	Nassau.	Nassau.	Prussia, between Bonn and Coblentz.	Bavaria.	Nassau, between Ems and Homburg.
Temperature	50° F. = 8° R.	50° F. = 8° R.	51° F. = 8° R.	52° F. = 9° R.	52° F. = 8¾° R.	63° F.
Carbonic acid	34 cu. in.	19·68 cu. in.	23·77cu.in.	17 cu. in.	30·24cu.in.	28·47cu.in.
Sum total of solid ingredients ..	26·45 grs.	25·33 grs.	11·25 grs.	15 grs.	30·39 grs.	28 grs.
Sulphate of soda ..	2·85	0·16	0·09	2·10	1·85	—
„ lime ..	—	—	—	—	0·77	—
Chloride of sodium	5·63	4·31	0·29	3	18·24	17·29
„ magnes.	—	—	—	—	3·05	—
Carbonate of soda	13·39	16·43	6·09	6·20	0·35	6·15
„ magnes.	2·61	1·73	2·23	2·40	—	1·37
„ lime ..	0·33	2·49	1·98	1·30	—	2·18
„ iron ..	1·62	0·08	0·16	—	—	—
„ mangan.	—	—		—	—	—
Silica	—	0·08	0·11	—	0·86	0·3

Sulphurous Waters (Theiopegæ).

	Aix-la-Chapelle.	Baden, near Vienna.	Eilsen, (Georgenbr)	Meinberg, (Schwefelquelle.)	Nenndorf. (Quelle unter dem Gewölbe.)	Warmbrunn at the foot of the Riesen Mountain.	Weilbach.*	
Situation	Rhenish Prussia.	Austria.	Lippe, Bückeburg.	Principality of Detmold.	Electoral Hesse.	Prussia.	Nassau.	
Specific gravity ..	—	—	1·003	1·001	—	—	—	
Temperature ..	136° F. = 46° R.	96°to 84°F.= 28½° to 23° R.	52°to 54°F.= 9° to 10° R.	49°F.=7½°R.	52° F.=9° R.	99° F. = 29¾° R.	55° F. = 11° R.	
Carbonic acid ..	8 cub. in.	0·5 cub. in.	1·44 cub. in.	2·12	5·29 cub. in.	0·02 cub. in.	5·63 cub. in.	
Carb. hydrogen ..	—	—	0·11	—	—	—	—	
Sulphur. hydrogen	0·13 cub. in.	0·7 cub. in.	1·57 cu. in. Julianenbr. 2·01	0·55	1·21 cub. in.	trace.	2·05 cub. in.	
							According to Jung.	Latest anal. according to Kastner.
Nitrogen	18·53 cub. in.	0·3 cub. in.	0·31 cub. in.	—	trace.	—		
Sum total of constituents ..	31·94 grs.	12.61 grs.	30 grs. Julianenbr. 21	19·48 grs.	21·49 grs.	4·07 grs.	30·54 grs.	12·21 grs.
Sulphate of soda ..	2·12	1·99	5·82	5·84	5·22	1·72	0·85	0·34
,, magn.	—	1·36	5·01	1·73	2·83	—	—	—
,, lime ..	—	3·20	15.28	8·33	7·15	—	—	—
Chloride of sodium	20·71	1·34	—	—	—	0·54	5·11	2·04
,, magnes.	—	0·36	1·29	1·03	1·63	—	2·23	0·89
,, calcium	—	—	—	—	—	—	—	—
Carbonate of soda	6·61	—	—	—	—	0·81	11·28	4·51
,, magn.	0·15	1·75	0·16	0·17	—	—	4·47	1·78
,, lime	0·23	1·80	2·33	2·14	4·30	0·15	5·56	2·22
,, iron	—	—	—	0·008	—	—	—	—
,, mang.	—	—	—	—	—	—	—	—
,, strontia	—	—	—	—	—	—	—	0·03
,, silica..	0·53	—	—	0·12	0·05	0·54	0·93	0·37

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* The constituents of Weilbach are supposed to have undergone a change.

Chief Chalybeates.

	Bocklet.* (Stahlquelle.)	Brückenau. (Eisenquelle.)	Driburg. (Drinking spring.)	Pyrmont. (Drinking spring.)	Schwalbach. (Weinbr.)	Spaa. (Pouhon.)	Wildungen. (Stadtbr.)
Situation	Bavaria.	Bavaria.	Westphalia.	Waldeck.	Nassau.	Belgium.	Waldeck.
Temperature	52° F.=9° R.	49° F.=7$\frac{3}{4}$° R.	50° F.=8° R.	52° F.=9° R.	49° F.=7$\frac{3}{4}$° R.	50° F.=8° R.	50° F.=8° R.
Carbonic acid	39·38 cu. in.	35$\frac{1}{2}$ cu. in.	41·65 cu. in.	44$\frac{1}{2}$ cu. in.	26·60 cu. in.	8·19 cu. in.	38·20 cu. in.
Sum total of solid ingr.	27·66 grs.	2·70 grs.	26·80 grs.	20·62 grs.	6·59 grs.	4·33 grs.	11·98 grs.
Sulphate of soda	2·54	—	3·88	2·14	0·16	0·03	0·91
„ magnesia ..	3·23	0·60	4·25	2·69	—	—	0·28
„ lime	—	0·20	8·42	7·22	—	—	—
Chloride of sodium ..	6·55	0·30	—	—	0·18	0·44	0·07
„ magnesium	4·43	—	0·53	1·12	—	—	—
Carbonate of soda ..	—	—	—	—	0·17	0·73	0·70
„ magnesia ..	3·36	0·15	—	0·32	3·12	1·12	4·05
„ lime	6·54	0·55	9·12	5·98	2·11	0·98	5·44
„ iron	0·61	0·25	0·51	0·49	0·83	0·37	0·19
„ manganese	—	—	0·07	0·04	—	0·05	0·07
Silica	0·22	—	—	0·49	—	0·49	0·27

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* The Ludwigsquelle contains 45 grains of solid ingredients; among these 27 grains of chloride of sodium, and 0·65 of iron.

Spas with predominance of Sulphate of Soda (*Pikropegæ*).

	Carlsbad, Sprudel.	Franzensbad.	Marienbad	Friedrichshall	Püllna	Saidschutz.	Seidlitz.
Situation..	Bohemia.	Bohemia, Franzensq.	Bohemia, Kreuzbt.	Saxen-Meiningen.	Bohemia.	Bohemia.	Bohemia.
Temperature ..	165°F.= 59° R.	53° F. = 9½° R.	53° F = 9½° R.	55° F.= 11° R.	— —	— —	— —
Carbonic acid ..	11·85 cu.in.	40 cub. in.	8.40 cu. in.	5 cu. in.	—	—	—
Sum total of constituents ..	41·93 grs.	42·22 grs.	66·18 grs.	194¼ grs.	251 gr.	178 grs.	126 grs.
Sulphate of soda ..	19·86	24·50	38·11	46½	123	46¾	—
„ magnes.	—	—	—	39½	93	84	104
„ potash	—	—	—	1½	4¾	—	—
„ lime ..	—	—	—	10⅓	2½	10	8
Chloride of sodium	7·97	9·23	13·56	61,1-10th	—	—	—
„ magnes.	—	—	—	30¼	19½	2	3
Carbon. of soda ..	9·69	5·18	7·13	—	—	—	—
„ magnes.	1·36	0·67	2·71	3, 1-10th	6½	5	3
„ lime ..	2·37	1·80	3·93	1-10th	¾	—	8
„ iron ..	0·02	0·23	0·17	—	trace	—	—
„ mangan.	—	0·04	0·03	—	—	—	—
„ silica ..	0·57	0·47	0·38	—	17-100	—	—
Bromide of magnes.	—	—	—	4-5th	—	—	—
Iodide of magnes.	—	—	—	—	3-100	—	—
Crenate of magnes.	—	—	—	—	1	—	—
Nitrate of magnes.	—	—	—	—	25	—	—

Chief Swiss Spas.

	Baden.	Bex, Minenquelle	Birmensdorf.	Leuk.	Schinznach.	Tarasp.
Situation	On the Limmat.	To the south-east of the Lake of Geneva, on the Rhone.	On the summit of the Petersberg, above Baden.	On the Rhone.	On the Aar.	On the Inn.
Temperature ..	146° F. = 51° R.	50° F. = 8° R.	46° F. = 6° R.	124° F. = 41° R.	89° F. = 25⅓° R.	48° F. = 7° R.
Carbonic acid ..	32 cu. in.	4 cu. in.	trace.	0·26	1·30	32 cu. in.
Sulphuretted hydr.	—	0·67 cu. in.	trace.	—	6·40	—
Nitrogen	—	—	—	0·34	—	—
Sum total of constituents ..	33·40 grs.	23·64 grs.	5·31 grs.	15·93 grs	24·64 grs.	93½ grs.
Sulph. of soda ..	2·28	3·77	—	0·50	6·40	16
„ magnesia	2·44	—	—	1·99	1·76	—
„ lime ..	10·86	0·153	0·09	12·71	7	—
Chl. of sodium ..	13·04	17·77	0·92	0·05	5·28	24
„ magnesium	0·56	—	—	0·02	2	—
„ calcium ..	0·71	—	0·09	—	—	—
Carb. of soda ..	—	—	—	—	—	39
„ magnesia	0·15	—	0·51	—	0·94	5
„ lime ..	2·60	1·93	1·85	0·35	1	7·50
„ iron ..	—	—	0·44	0·02	—	1
Silica	—	—	0·06	0·10	—	—
Extractive subst.	—	—	1·18	—	—	1

Chief French Spas.

	Aigues Chaudes.	Aix-les-Bains.	Bagnères d'Adour.	Barèges.	Bourbonne les Bains.	Cauterets.	Vichy.
Situation	At the foot of the Pic du Midi.	Savoye.	At the foot of the Pyrenees.	Department of Upper Pyrenees.	Department of Upper Marne.	Upper Pyrenees.	Upper Allier.
Temperature	95° F.	116° F.	129° F.	112° F.	136° F.	122 ° F.	109° (Gr.grille) to 66° (Celest.)
Carbonic acid	—	0·02 cu. in.	Undetermined.	—	0·34 cu. in.	2·10 cu. in.	15·21 cu. in.
Sulphuretted hydr.	—	0·04		—	—	3·74 cu. in.	—
Nitrogen	—	0·03	—	0·10	0·34	—	—
Sum total of constituents ..	3·91 grs.	3·30 grs.	9·87 grs.	1·65 grs.	61·44 grs.	1·46 grs.	38·75 grs.
						Source des Espagnols.	
Sulphate of soda ..	—	0·73	—	0·38	—	—	2·10
Sulph. of sodium ..	—	—	—	0·36	—	—	—
,, magnesia	1 54	0·27	1·97	—	—	0·28	—
,, lime ..	2·50	0·12	5·86	—	6·04	0·59	—
,, alumina	—	0·42	—	—	—	—	—
Chl. of sodium ..	0·50	0·06	0·34	0·30	46·11	0·14	4·28
,, magnesium	0·36	0·13	0·29	—	—	0·14	—
,, calcium ..	0·81	—	—	—	5·68	—	—
,, magnesia ..	—	—	—	0·02	—	—	—
,, lime	—	—	—	0·02	—	—	—
,, caustic soda	—	—	—	0·03	—	—	—
Sulphu. sulfuraire ..	0·09	—	—	—	—	—	—
Carb. of soda	—	—	—	—	—	—	29·28
,, magnesia ..	—	0·19	—	—	—	—	0·41
,, lime	0·81	1·14	1·32	—	2·20	0·24	2·18
,, iron	—	0·06	—	—	1·03	—	0·06
,, manganese	—	—	—	—		—	—
Silica	0·07	0·03	0·07	0·51		0·06	0·41
Extractive subst. ..	—	—	—	Baregine.	—	—	—
Brom. of potassium	—	—	—	—	0·38	—	—
Alt. above the sea ..	—	768 feet.	1700 feet.	4000 feet.	870 feet	2900 feet	—
Fluoride of calcium, phosph. of lime ..	—	0·01	—	—	—	—	—

Some of the Chief English Spas.—According to Mr. Brande.

	Bath.	Buxton.	Cheltenham,* chalybeate.	Harrowgate.	Leamington,† New Bath.	Malvern, according to Philip.	Tunbridge Wells.
Situation	Somersetshire.	Derbyshire.	Gloucestershire.	Yorkshire	Warwickshire.	Worcestershire	Kent.
Temperature ..	116° F.	82° F.	—	54° F.	59° F	50° F.	50° F.
Carbonic acid ..	1·2 cu. in.	—	2·5 cu. in.	1 cu. in.	trace	—	1 cu. in.
Sulph. hydrogen	—	—	—	2·3 cu. in.	trace	—	trace of oxygen
Nitrogen	—	0·2	—	0·8	0·4	—	0·59
Total of contents	14·6 grs.	1·83 grs.	73·8 grs.	94 grs.	88·3 grs.	0·80 grs.	0·56 grs.
Sulph. of soda ..	1·5	—	22·7	—	19	0·16	—
,, magn.	—	—	6	1·3	—	—	—
,, lime	9	0·3	2·5	—	14	—	0·17
Chlo. of sodium	3·3	0·2	41·3	77	53	0·10	0·30
,, magn.	—	—	—	11	1·5	—	0·03
,, calcium	—	—	—	1·5	—	—	0·05
Carb of soda ..	—	—	0.5	—	—	0·38	—
,, magn.	—	—	—	0·7	—	0·02	—
,, lime ..	0·8	1·3	—	2·5	—	0·03	0·03
Oxide of iron ..	trace	0·03	0·8	—	0 8	0·03	0·28
Silica	0·2	—	—	—	—	—	—

* Cheltenham *sulphur spring* contains 1·5 cubic inches of sulphuretted hydrogen, and 65 grains of solid ingredients, similar to the above, possessing, however, rather less chloride of sodium, and half a grain less of oxide of iron. Cheltenham *saline spring* contains 80½ grains of solid ingredients—viz., 15 sulphate of soda, 11 sulphate of magnesia, 4½ sulphate of lime, and 50 chloride of sodium.

† Leamington *Old Bath* contains 0·3 cubic inches of nitrogen, and 73½ grains of solid ingredients—viz., 7½ sulphate of soda, 7 sulphate of magnesia, 18 sulphate of lime, 41 chloride of sodium.

Analysis of the chief Mineral Waters prepared at the Brighton Pump Room, as stated by Dr. Franz, on the authority of Mr. E. Schweitzer, Director and Principal Chemist of that Establishment.

	Carlsbad.	Franszenbr. of Franzensbad.	Marienbad. Ferdinandsbr.	Obersalzbr. of Silesia.	Pyrmont.	Saratoga. Congress Spring.	Viehy. Grandegrille.
Temperature ..	165° F. Sprudel. 138° F. Neubr. 128° F. Mühlbr. 122° F. Theresienbr.	54° F.	49° F.	58° F.	56° F.	50° F.	108° F.
Carb. acid in 100 cub. in.	58	154	146	98	160	114	49
Sum total of const.	31·46 grs.	31·66 grs.	34·47 grs.	14·73 grs.	15·42 grs.	32·74 grs.	29·18 grs.
Sulphate of soda ..	14·90	18·37	16·90	2·51	1·60	—	0·67
,, magn.	—	—	—	—	2·36	—	—
,, potash	—	—	—	0·31	0·03	0·13	1·17
,, lime ..	—	—	—	—	5·02	—	—
,, strontia	—	—	—	—	0·01	0·06	—
Chlor. of sodium..	5·98	6·92	6·74	0·86	—	19·66	3·33
,, potass...	—	—	—	—	—	1·62	—
,, magnes.	—	—	—	—	0·84	—	—
,, ammon.	—	—	—	0·01	—	0·03	—
Subphos. of lime..	—	0·01	—	—	—	—	0·002
,, magn.	—	—	—	0·01	—	—	0·01
Carbon. of soda ..	7·27	3·89	4·59	7·62	—	0·82	21·90
,, ammon.	—	—	—	—	—	—	0·02
,, magnes.	1·02	0·50	2·28	1·54	—	4·11	0·20
,, strontia	—	—	—	1·01	—	—	0·01
,, lime ..	1·77	1·35	3·00	1·54	4·77	5·85	1·44
,, iron ..	0·02	0·17	0·29	1·03	0·32	0·017	—
,, alumina	—	—	—	—	0·01	—	—
,, mangan.	0·004	0·03	0·06	0·002	0·03	0·02	0·002
,, lithia ..	—	0·02	0·05	—	—	—	—
Silica	0·43	0·35	0·50	0·24	0·37	0·11	0·36
Nitrate of magnes.	—	—	—	—	—	0·10	—
Bromide of sodium	—	—	—	0·005	—	0·16	0·0007
Iodide of sodium ..	—	—	—	—	—	0·004	0·0002
Fluoride of calcium	0·018	—	—	—	—	—	—
Alumina	—	—	—	—	—	0·006	0·004

Besides the foregoing, they prepare Adelheidsquelle of Heibrunn, the bitter waters of Püllna and Seidschütz, Elisenbrunnen of Kreuznach, Fachingen, and Geilnau water, Kesselbrunnen of Ems, Kreuzbrunnen of Marienbad, Pouhon of Spa, Ragozi of Kissingen and Seltzer water, all according to the most minute and careful analysis, and without omission of the smallest fraction of any substance discovered in the natural springs; but as they are readily procured from the importers in their natural state, their analyses seemed less required.

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THE END.

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ERRATA.

Page 3, line 18, *for* gentlemen *read* gentleman.
— 48, — 17 from bottom, *for* theia *read* theio.
— 58, — 12 from bottom, *for* 'of' the organism *read* 'on.'
— 59, — 12, *for* systemmicic *read* systemic.
— 77, — 16 from bottom, *for* invisible *read* visible.
— 96, — 2 from bottom, *for* the *read* thee.
The phrase in parenthesis to be transferred as a foot note to the following page (explanatory of the first line of page 97.)
— 128, — 7, *for* Kiel *read* Reil.
— 132, — 13, *for* erethric *read* erethic.
— 137, — 13 from bottom, *for* two of soda *read* two of sulphate of soda.

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